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THE ROUTES TO THE NORTH POLAR REGION.*

THE recent return of the American Expedition under Captain Hall, and the addition of another 120 miles to our knowledge of the great unknown area round the North Pole by way of Baffin's Strait and Smith's Sound, adds remarkable confirmatory evidence of the value of that route, as the right one for the resumption of British Arctic discovery, and shows how wise and sound were the conclusions arrived at by the Committees of the Royal Society and the Royal Geographical Society in urging on our Government during the last two years the sending forth of an Arctic expedition up the remarkable series of straits which extend between Greenland and the American Arctic Archipelago.

Before recapitulating, from the memorandum drawn up by those two Societies, the scientific results likely to accrue from such an expedition, and their reasons for recommending the route in question, let me call the attention of this section of the British Association to the salient geographical features of that portion of the Arctic zone which lies northward of the American continent. I have, in a paper read before the Royal Geographical Society, in April 1873, shown, that whereas the three great continents of America, Asia, and Europe, all terminate in about the 70th parallel of latitude, leaving a vast crater in the earth's surface of about 2400 miles in diameter, there are two points at which that great area is bridged across by lands projected from the Asiatic and American continents at Grinnell Land—longitude, 70° W.; and Cape Taimyr—longitude, 105° E., until the intervening space is only 1080 miles wide, whereas a line across the Pole from Spitzbergen to Behring's Straits, at right angles to it, would be 1800 miles. Therefore it is clear that an expedition starting from the head of Smith's Channel across the Pole to the nearest known point of Asia, would have about 800 miles less unknown ground to traverse than one from Spitzbergen across the Pole to the American shore at Behring's Straits. This is one of my main reasons for having continuously adhered to the Smith Sound route as the right one for the exploration of the Polar area.

Another remarkable feature is as follows:—It appears, on looking at the circumpolar chart, that although the three continents terminate, as I have before said, in the 70th parallel, they each throw off to the northward great outlying groups of islands. Europe has its Spitzbergen group, which has now been thoroughly explored, and its scientific features nigh exhausted; and we know from Parry's remarkable boat journey, 120 miles north of it, that in remarkably clear weather no lands were seen to the northward, and it may, therefore, be fairly concluded that the European Arctic archipelago terminates there.

Asia has doubtless, in the Liakov group and Wrangel or Kellett's Lands, its Arctic archipelago, but as yet not traced nearer than 15 degrees of the Pole.

Turn now to the Western hemisphere, and note that from Greenland to Bank's Land, over 100 degrees of longitude, there is a great series of lands which have been traced from the 70th parallel up to the 84th, or within 360 miles of the Pole itself, and with no symptom of its termination there.

Greenland itself, on the western side, has been visited by Hall's Expedition up to latitude 83°, and found abounding in a remarkable degree with animal life; and, on its eastern shore, the German Expedition under Captain Koldewey, in 1870, wintered in 75° N., traced the land to 77°, and shot as many reindeer and musk oxen as they wished.

There can, therefore, be no question that of the three Arctic archipelagos the most extensive, the most worthy of exploration, the best in its resources and climate, and the one nearest to the Pole, is the American one, in which I comprise Greenland. To that portion of the Arctic Regions I now direct your attention. One of its most singular features is the remarkable manner in which it is divided or cut up by deep water channels running in generally north and south, and east and west directions, forming a series of straits unparalleled for length on any other portion of the globe. The longest of these, and the most remarkable, is the one which extends along the west side of Greenland. This long strait bears in different parts the names of its various discoverers, since John Davis entered it in 1587, and Baffin, in 1616, sighted and named Smith Sound, up which the American expeditions of Kane and Hall since 1860 have carried it, as I before said, to the 84th parallel. This strait is, therefore, known to be nearly 1600 miles long—the longest, certainly, as yet known amongst straits, but there are many others here nearly as remarkable. That from the bottom of the Gulf of Boothia to the head of Wellington Channel is fully 700 miles long; and we have besides three other straits traversing this archipelago in an east and west direction, almost

* Read at the Geographical Section of the British Association at Belfast, August 1874.

parallel to each other, known under the general terms of Dolphin and Union Strait, Barrow Strait, and Jones' Strait, two of which are each 800 miles, and one 550 miles in length.

There is one feature connected with these straits, which run in a northerly direction, notably the Wellington and Baffin Straits, that down them there is a constant southerly motion of ice, as well verified by the long drifts made down them into the Atlantic Ocean, by four or five different expeditions that have been beset in the ice. Ross in 1849, De Haven in 1851, Kellett in 1854, McClintock in 1860, and, lastly, the crew of Hall's vessel, who drifted on a mass of ice from Smith Sound down to the coast of Labrador. These drifts from north to south testify to the fact that all these channels are open to the north into some great Polar Ocean, whence these ice-bearing currents issue.

It is this law of the southerly outpour of the ice formed within the Polar Regions, through these great straits, and its continuous character summer and winter, which has always been the difficulty in the way of Arctic exploration. There is no outlet for it except into the Atlantic; the Behring's Strait outlet into the Pacific is too shallow, and too narrow to be considered in the general question. It is on either side of Greenland that the true outpour of that enormous area of ice takes place; and the explorer who has to penetrate to the Pole against this ice current must seek for land to carry him up to such a position that he shall reach, during summer, the water space, if any, at the Pole, from whence the summer heats have caused the ice to flow.

In the broad channel between Spitzbergen and Greenland the major outflow of this ice takes place. The Spitzbergen shores terminating in 80°, every attempt to stretch northward in that direction, extending over a hundred years, has failed utterly; and the theory that between Spitzbergen and Novaya Zemlya, a water channel will be found to the Pole, is a pure hypothesis, founded on no fact, and totally at variance with all experience.

On the western side of this great outlet between Greenland and Spitzbergen, the East Coast of Greenland, if followed up, offers at first sight a means whereby the explorer might advance. English navigators repeatedly attempted it, but found the outpour of ice so heavy, so continuous, and impinging so much upon the coast, that up to 1823 no one had advanced beyond Shannon Island, and that route was declared by us impracticable.

In 1868, however, Dr. Augustus Petermann of Gotha, having special theories of his own which set aside the long experience of British Arctic navigators, persuaded his German countrymen that the East Coast of Greenland was the right route for the exploration of the Polar area. The result was that, in 1869-70, an expedition, composed of two ships, the 'Germania' and 'Hansa,' set forth, under Captain Koldewey, on this ill-judged purpose. It has been long known to us how they failed, in spite of the most gallant endeavours and the heroic sufferings of all concerned, and how Dr. Petermann, having tested the fallacy of one of his theories, clings obstinately to the other, that an expedition should be sent between Spitzbergen and Novaya Zemlya, a work taken up by the Austrians under the command of a military officer named Payer, one of Koldewey's associates. Payer's expedition is of course now missing, rewards have been offered for the discovery of his whereabouts, and an Englishman has started, aided by the liberal purse of our gallant associate Mr. Leigh Smith, to try to rescue him.

The labours of the Koldewey Expedition have never been sufficiently appreciated in this country; but I am happy to believe that when the excellent translation of the "German Arctic Expedition" of 1869-70 is published, next October, by the spirited publishers Messrs. Sampson Low & Co., under the able editorship of Mr. Bates, that we shall better understand how well Koldewey and his companions laboured to carry out Dr. Petermann's impracticable theory, and that they were merely foiled by the same difficulties which our seamen had found insurmountable. I have read the proof sheets of this remarkable work, and can safely aver that in the long record of Arctic discovery and heroism in that cause, nothing can exceed the sufferings of the crew of the 'Hansa,' who, after their vessel was smashed in the ice, lived on a drifting ice-floe through a long winter of 200 days, and drifted some 600 miles down the whole coast of East Greenland.

Koldewey himself, in the 'Germania,' wintered where Clavering and Sabine did in 1823, and added this information to our knowledge of Greenland—that the coast-line was continuous to 77° N.; that a short way in the interior the climate and vegetation improved remarkably; and that animal life, in the form of bears, seals, walrus, musk oxen, and reindeer was singularly plentiful.

Koldewey, the leader of this expedition, on his return recorded his opinion that he had been radically cured by his winter experiences on the East Greenland route of any belief in Dr. Petermann's theories, and says, to use his own words: "If the principal object (of an expedition) be the nearest possible approach to the Pole, I am quite of Osborn's opinion that the best way appears to be through Smith's Sound. Here one can penetrate by ship every year to the 78th parallel, and then one has a continuous line of coast running north, which has been sighted as far as the 82nd parallel. Along this coast one would have to work one's way in spring with dog-sledges. *I consider it a wild undertaking to penetrate towards the Pole by ship between Spitzbergen and Novaya Zemlya.*"

We will now turn our attention to Baffin's and Smith's Straits. The various names which dot this remarkable channel denote pretty clearly the arduous labours of explorers over three centuries of time. In 1585 Davis appears to have reached as far as the modern Danish settlement of Upernivik, and named a headland there after his patron, Sanderson, a wealthy London merchant.

Then came Baffin, in 1616, and in his little barque 'Discoverer' sailed round what was then thought to be a berg, and discovered not only the entrance to Barrow's Straits, which subsequent British navigators have found to lead to the Pacific Ocean, but he also laid down the entrance of Smith's Sound about 79° N., which American navigators in our time have gallantly shown is the true route to the great unknown region round our northern Pole. My lamented friend Dr. Kane was the first, with true genius, to grasp the idea, and, in 1855, in a small vessel hardly better fitted for Arctic discovery than Baffin's craft of 200 years before,

pushed into this strait some 90 miles, and laid it open to human knowledge, about 150 miles in all, or to latitude 80° 40′ N. Astonished at the amount of navigable water he found, and the abundance of proofs that he was approaching instead of receding from an open sea, he, with pardonable enthusiasm, returned home, after suffering incredible hardships (owing to imperfect equipment), and reported, what was no doubt his belief, that he had seen, though he had not reached, an open Polar sea. Prior to his death I had frequent opportunities of conversing with him on the subject, and he fully made me a believer, to a certain extent, in his theory that Smith's Sound was the real route to the North Pole, though I saw many reasons for believing that the lands he had visited were continuous far beyond points seen, and that theory I committed myself to as far back as 1865, in a paper communicated to the Royal Geographical Society, and urged that we should take up the clue and secure to British seamen the honour of Polar discovery, as we had already done the exploration of the other great geographical problem, the North-West Passage.

The Americans, fired by the Arctic achievements of Kane, sent out soon after his return another expedition under Dr. Hayes. He, however, did but little beyond confirming much of Kane's report, and bringing proofs that within a few miles of where Kane wintered and nearly starved, he had found abundance of game and food.

The next American who attempted Smith's Sound was Captain Hall, who, having acclimatized himself by spending five winters amongst the Esquimaux of Davis Straits, devoted himself to the discovery of the Pole. The United States Congress voted him $50,000, and the American Geographical Society, New York, still further assisted him; but beyond great personal energy and enthusiasm, Captain Hall possessed but few qualifications to fit him for the serious task he had embarked in, and his vessel, the 'Polaris,' was as ill-fitted for his purpose as his companions were ill-assorted. After various mishaps in starting, he left the Danish settlement in Greenland finally in August 1871, and almost without a check from ice, reached some 120 miles further up Smith's Sound than ever Dr. Kane had seen, or to latitude 82° 16′ N. Here the 'Polaris' first encountered ice, and Hall's sailing captain, a man evidently possessing no qualification for the post, immediately induced Hall to take shelter at the nearest anchorage, despite, as the published evidence shows, of the opinion of all his officers. Captain Hall died suddenly in the autumn of 1871. The expedition became at his death utterly disorganized, and nothing further was done in 1872, although the prospect of further progress was most encouraging. The results, however, of the 'Polaris's' voyage may be briefly summed up: the shores of this remarkable strait, varying from 40 to 100 miles in width, were seen extending as far as eye could reach, and in a published chart, to which the American official seal has been attached, now in our Admiralty office, the 'Polaris' is credited with having discovered lands to 84° N. The eastern shore was found abounding in animal life; the climate declared to be milder than further south; the vegetation more abundant; the ice of the sea comparatively open; sea-birds numerous; a tidal action from the north perceptible; and every indication of more open water to the north.* Here we have positive information of a region actually visited in 82° N., or only 480 miles from the Pole, of a most encouraging character, and the explorers report that they saw lands of a similar character to those they were upon, extending to the 84th parallel, which is only 360 miles from the Pole.

I am stating an Arctic axiom, that wherever a navigator has seen lands and returned without visiting them, a subsequent expedition has always succeeded in reaching them; and I cannot be charged with being rash in asserting that whatever the latitude seen into by the crew of the 'Polaris,' a new expedition will assuredly reach, if not pass it; and assuming that a properly equipped British expedition goes in 1875, I have no doubt of its attaining latitude 84° at the least. If so, with our knowledge of Arctic boat and sledge work, of which the American expedition was totally ignorant, or failed to avail itself, the Pole itself is easily attainable. I will go further: from the quantity of driftwood, open water, and constant current observed by these Americans at their furthest point, there is every reason to believe that there exists a water communication, partially encumbered with ice, across the Polar area to the shores of the Asiatic continent, whence that wood comes, and it is quite within the bounds of probability that a bold navigator will, by holding on to the coast of the western shore, find himself in an Arctic summer, in a comparatively navigable sea near the Pole, and across to Asia whence the great masses of field-ice flow, which hamper the wide outlet into the Atlantic between Spitzbergen and Greenland, in one vast ice stream.

Some twenty years ago I stood on Western Greenland looking up at a mighty headland, named by the great navigator Davis "Sanderson, his Hope of a North-West Passage," and bethought me of the earnest faith of that old seaman who, 300 years ago, believed that one day his countrymen would pass across the wide and unknown space between it and the Pacific. Four years afterwards, I passed that great headland in company with M'Clure and his heroic companions, who had realised the hopes of old Davis. May we not in our generation be as confident of human progress and British adventure in another direction, and, looking at the mighty portal of Smith's Sound, express our hope that by the great headlands of Capes Isabella and Alexander, will before long pass a British expedition to lay open to human knowledge that great area of two millions square miles of unknown space which lies around the Northern Pole of our globe.

To those who have not closely, of late years, followed the subject of Arctic research, and are unacquainted with the scientific results likely to be reaped by a Polar Expedition, the question may arise—What are likely to be the useful results of a fresh expedition in that direction? The best answer I can give to such a query is an abstract from the memorandum of the Arctic Committee of the Royal Society, which has been formally presented to our Government. In a general sense they say—

"The results of scientific importance to be derived from an examination of the immense unknown area round the North Pole, are as numerous as the region to

* See letters of officers of 'Polaris' to President of American Geographical Society, published 1874.

be explored is extensive. It may be shown that no such extent of unknown area, in any part of the world, ever failed to yield results of practical as well as of purely scientific value; and it may safely be urged that as it is mathematically certain that the area exists, it is impossible that its examination can fail to add largely to the sum of human knowledge. Further, it is necessary to bear in mind that the Polar area is, in many most important respects, of an altogether special character; affording exclusive opportunities for observing the condition of the earth's surface, and the physical phenomena there to be seen, under certain extreme and singular circumstances, which are due to the relation of this area to the position of the axis of revolution of the terrestrial spheroid, and which have to be considered, not only with reference to the present time, but to the earth's past history. It may be, therefore, received as certain that discoveries will be made in all branches of science, the exact nature of which cannot be anticipated. But there are also numerous objects, that have been stated and enumerated by the presidents and officers of the several scientific societies, the attainment of which make it desirable to despatch an Arctic expedition of discovery."

Of hydrography, they report—

"An Arctic expedition is a necessary complement to the expedition now investigating the ocean bottom in the middle and southern latitudes of the globe. The hydrography of the unknown seas has a most important bearing on the general question of oceanic currents, a question which is of practical consequence to navigation. Our knowledge of the general system of currents will be incomplete without an investigation of the currents, deep-sea temperatures, and sounding in the unknown area. Observations, at great depths, with the improved instruments now in use, would be of much value in connection with the like observations which are being carried on by the expedition now exploring the tropical seas."

Then they enumerate many other branches of science which would be enriched, and many problems solved by the research recommended, and they dwell particularly on botany, the report on which, as it embodies the views of the learned President of the Royal Society, Dr. Hooker, deserves to be given *in extenso*:—

"The vegetation of the Arctic Regions, in the opinion of Dr. Hooker, throws great light upon the geographical distribution of plants on the surface of the globe. On the return of Sir Edward Belcher's Expedition from those regions, a series of rocks collected in the neighbourhood of Disco, by his former fellow-voyager, Dr. Lyall, were placed in Dr. Hooker's hands, containing an accumulation of fossil leaves of plants totally different from any now growing in that latitude. These fossils he forwarded to Professor O. Heer, of Zürich, for investigation, who had brought forward the most convincing proofs that that latitude was once inhabited by extensive forests, presenting fifty or sixty different species of arborescent trees, most of them with deciduous leaves, some 3 or 4 inches in diameter—the elm, pine, oak, maple, plane, &c.; and, what was more remarkable still, evidences of apparently evergreen trees, showing that these regions must have had perennial light. It seems extremely probable that the vegetation, which belonged to the Miocene period, extended over a large portion of the Northern Arctic Regions. It would be of great interest to ascertain whether such vegetation extends towards the Pole; and there is nothing that would give greater assistance in solving this problem than the proposed expedition along Smith Sound. Turning to the existing flora of Greenland, Dr. Hooker has pointed out that, though one of the most poverty-stricken on the globe, it is possessed of unusual interest. It consists of some 300 kinds of flowering plants (besides a very large number of mosses, algæ, lichens, &c.), and presents the following peculiarities:—1. The flowering plants are almost without exception natives of the Scandinavian peninsula; 2. There is in the Greenland flora scarcely any admixture of American types, which nevertheless are found on the opposite coast of Labrador and the Polar Islands; 3. A considerable proportion of the common Greenland plants are nowhere found in Labrador and the Polar Islands, nor, indeed, elsewhere in the New World; 4. The parts of Greenland south of the Arctic Circle, though warmer than those north of it, and presenting a coast 400 miles in length, contain scarcely any plants not found to the north of that circle; 5. A considerable number of Scandinavian plants which are not natives of Greenland are nevertheless natives of Labrador and the Polar Islands; 6. Certain Greenland and Scandinavian plants which are nowhere found in the Polar plains, Labrador, or Canada, re-appear at considerable elevations on the White and the Alleghany and other mountains of the United States. No other flora known to naturalists presents such a remarkable combination of peculiar features as this, and the only solution hitherto offered is not yet fully accepted. It is that the Scandinavian flora (which Dr. Hooker has shown evidence of being one of the oldest on the globe) did, during the warm period preceding the glacial—a period warmer than the present—extend in force over the Polar Regions including Greenland, the Polar American Islands, and probably much now submerged land in places connecting or lying between Greenland and Scandinavia, at which time Greenland no doubt presented a much richer Scandinavian flora than it now does. On the accession of the glacial period, this flora would be driven slowly southward, down to the extremity of the Greenland peninsula in its longitude, and down to the latitude of the Alleghanies and White Mountains in their longitudes. The effect in Greenland would be to leave there only the more Arctic forms of vegetation, unchanged in habits or features; the rest being, as it were, driven into the sea. But the effect on the American continent would be to bring the Scandinavian flora into competition with an American flora that pre-occupied the lands into which it was driven. On the decline of the glacial epoch, Greenland, being a peninsula, could be repeopled with plants only by the northward migration of the purely Scandinavian species that had been previously driven into its southern extremity; and the result would be a uniform Scandinavian flora throughout its length, and this an Arctic one, from north to south. But in America a very different state of things would supervene: the Scandinavian plants would not only migrate north but ascend the Alleghanies, White Mountains, &c.; and the result would be that, on the one hand, many Scandinavian plants which had been driven out of Greenland, but were preserved in the United States, would re-appear on the Polar Islands and Labrador, accompanied with sundry American mountain types, and, on the other, that a few Greenland-Scandinavian types, which had been lost in the struggle with the American types during their northward migration, and which hence do not re-appear in the Labrador and Polar Islands, might well be preserved in the Alleghanies and White Mountains. And, lastly, that a number of Scandinavian plants, which had changed their form of habit during the migration in America in conflict with the American types, would appear in the Polar Islands as American varieties or representative species of Scandinavian plants.

"Whether or no this be a true hypothesis, it embraces all the facts; and botanists look anxiously to further explorations in the northern parts of Greenland for more light on the subject, and especially for evidence of rising or sinking of the land in Smith Sound and the countries north and east of it, and for evidence of ancient connection between Greenland and Scandinavia; for ob-

I.E. Davis, delt.

CONTOUR CHART of the ATLANTIC OCEAN from Soundings to 1874.

Malby & Sons, lith.

servations on the temperature, direction, and depth of transporting currents in these seas, and on the habits of its ruminant migrating animals, that may have influenced the distribution of the vegetation by transporting the seeds. Such facts as those of the existence of ancient forests in what are now Arctic regions, and of the migration of existing floræ over lands now bound fast in perpetual ice, appear to some naturalists to call for vaster changes than can be brought about by a redisposition of the geographical limits of land and sea, and to afford evidence of changes in the direction of the earth's axis to the plane of its orbit, and perhaps of variations in the ellipticity of the orbit itself.

"It has thus been shown that much interest attaches to the Greenland flora, which is far from being exhausted. And besides these general questions, there are others respecting specific subjects, of which our existing knowledge is very imperfect. A great interest attaches to the minute forms of vegetable life which swarm in Polar areas, affording food to the Cetaceæ and other marine animals, and which colour the surface of the ocean and its bottom likewise. Many of these forms are common to the Arctic and Antarctic seas, and have actually been far better studied in the latter than in the former sea. Of land plants the lichens and mosses require much further collection and study, and the Arctic marine flora is most imperfectly known. Ample collections of flowering plants should be made, with a view of testing the variability of species and their distribution; and observations on the means of transport of land plants, by winds, currents, ice, and migrating animals, are very much wanted."

This is the reply to the question suggested, and I submit that it is amply conclusive, and from the highest authority in Great Britain, if not in the world, and I take my leave of the subject for the present, hoping that before the next meeting of this Association, we shall have sent forth the reapers to reap the harvest which awaits us of honour and renown in the grim regions of the North, a service which I vouch, if properly sent, under Government auspices, will not return empty handed, and in which those chosen, I go bail, will be envied by their less fortunate brethren of my profession.

SHERARD OSBORN,
Rear-Admiral, C.B., F.R.S.

THE VOYAGE OF THE 'CHALLENGER.'

IV.

WITH regard to the contour or form of the earth beneath the waters (see contour chart), the North Atlantic may be said to be tolerably well delineated, still this delineation must be accepted with caution; and although much may be allowed between the necessity of having heights within certain distances for contouring the earth above the water, and depths for doing the same beneath the water, we have but to imagine how very erroneous any contour of the earth's surface would be if we had but a few elevations across the continent, 100 to 300 miles from each other, and in lines 1000 or 1200 miles apart, for the groundwork from which to draw the configurations. It would also be seen how possible it would be for some of the most extensive mountain ranges to be altogether left out: indeed, no form of the earth, such as we know it to be, could be delineated from such material. To a great extent the same difficulties must exist in attempting to contour the bottom of the ocean, which possibly may have its mountain ranges on which the sinker has never struck. But, from the soundings obtained, a contour can be drawn, subject to the doubt expressed, and strange to say that in those places where we might reasonably infer that the islands which do seem to form the summits of the same submerged mountain ranges have deep water between them, such as St. Helena to Ascension, and St. Paul Rocks to Fernando Noronha, and even the peaks of Tristan da Cunha group have a depth of 6000 feet between them.

In the North Atlantic the number of soundings enable us to present a very good idea of its conformation. First, we have the 'Challenger's' line across the ocean, near and cutting through the Equator; the second, from the Canary Islands to the West Indies; the third, from the Azores to Bermuda, and also north of Bermuda, by the same vessel; the lines of the Atlantic cables previously sounded; and that also of the projected North Atlantic route by Færoe, Iceland, Greenland, and Labrador, besides a number of independent soundings which for this purpose are applicable; but in the South Atlantic we have but the one line sounded by the 'Challenger,' with the soundings far apart, and but very few independent ones, so that the attempt to contour the bottom south of the Equator is of a very speculative character.

The contours in the North Atlantic present an irregular belt, in form like the letter ∪ reversed, exceeding 2500 fathoms in depth from very near the coast of the United States and the Bahama Islands, towards the African Coast, between the Canaries and Cape Verde Islands, and to within 350 miles of the coast, while two channels run to the north and to the south—those to the north running between Madeira and San Miguel to the latitude of the English Channel, and between the Milne Bank and the Bank of Newfoundland to about latitude 48° N.; whilst to the south the channels run on either side of the Dolphin Rise, that to the west extending only to about latitude 12° N., but the other running to the south-east, parallel to the African coast into the South Atlantic. The 2000 fathoms contour lengthen the channels on either side of the Azores: on the east side, towards Greenland to 52° N., and on the west side to the entrance of Davis Strait. These two gullies indicate that a bank of less than 2000 fathoms extends from Greenland to the Azores. To the south, the 2000 fathoms channel on the west side of the Dolphin Rise is carried between St. Paul Rocks and Fernando Noronha, and between Fernando Noronha and the American coast, into the South Atlantic. Of course this 2000 fathom contour is the best defined; but every intermediate reliable sounding hereafter obtained will prove of great service in verifying or otherwise these contours. A further examination of the Dolphin Rise will be most interesting; and the vast shoal, of which the group of the Azores is the nucleus, and which extends north and south about 700 miles, with a depth under 1500 fathoms, would also be a portion of interest for closer examination.

The nature of the bottom at a depth exceeding about 2700 fathoms, as being a kind of red clay, was commented on in the previous account of the 'Challenger's' proceedings; and although this red deposit was not found in the section crossing the Equator, it was again met, as red mud, in the deep but rather shoaler water in the section across the South Atlantic, both on the African and South American sides.

The important bearing which the temperature of the ocean at various depths has upon the question of its general circulation, is admitted, as it was one of the primary objects of the expedition; and whether the Polar cold or the Equatorial heat be the *primum mobile* of this vast system, the facts as recorded by the observations of the 'Challenger' must be the groundwork, or bases of the arguments, on which the theory is to be established; and whether we look through the figures as depicted in the curves, or the general results as delineated in the sectional diagrams of the serial temperatures, we are equally struck with the care and attention, as well as the labour, that has been devoted to the subject.

To ensure as good a comparison as possible, the same line was always used in obtaining serial temperatures. They were frequently observed at every 100 fathoms between the surface and a depth of 1500 fathoms, from seven to ten thermometers being secured to the line at one time, with a bottom-sinker of half-a-hundred-weight. Every attention was paid to ensure the line being up and down; for with a surface-current it is difficult to be certain whether it is or not, unless a very heavy weight be used. This would endanger the loss of instruments by the great strain on the line when heaving in. With all the care taken, the index registers frequently denoted a temperature that could not possibly be at the depth to which the thermometer had been submerged; and the only way that this deviation from the truth could be accounted for would be, that the indices had been moved by the vibration caused by the surface-current through which the line to which the instruments are attached, is being drawn.

All the temperatures noted were corrected for pressure as found by previous experiment; and when it is stated that the maximum error due to pressure never exceeded 1.4° or 1.5°, and that, for all practical purposes, progressive in proportion to depth, it may well be conceived that no error can amount to more than three or four tenths of a degree, which, when considered in connection with the difficulty of reading the instrument to such accuracy, may be assumed to be positive, as errors arising from, and due to mechanical construction are generally so great as to render their record so far satisfactory as to leave no doubt in regard to their rejection.

The temperature of the water at the Equator east of St. Paul Rocks, is considered at its normal state at all depths, cooling as it does gradually as the depth increases, and undisturbed by currents except at the surface, and that any deviation from this normal state is caused by movement of the water. Thus, notwithstanding the great increase of heat in the surface water at the Equator, the decrease in temperature is so rapid, that with a surface temperature of 78°, at a depth of 60 fathoms, the temperature is 61° 5′, the same as at Madeira at the same depth; and, at a depth of 150 fathoms the temperature is 50°, the same as in the Bay of Biscay at the same depth.

Beneath the water immediately affected by the sun's rays*—which is not believed to extend below 60 or 80 fathoms—all the water in the North Atlantic, as far north as the 40th degree of latitude, is warmer than at the same depth at the Equator. The only exception to this is at Bermuda, where, between 850 and 1500 fathoms, the temperature is slightly less. This may be accounted for by the action of the Labrador current passing under the Gulf Stream; and it is the only instance in which the action of Arctic water could be traced. The mean temperature of the upper 1500 fathoms of water in the North Atlantic is four degrees and a half warmer than at the Equator.

In the northernmost serial-temperature section—(see Table of Isothermal Sections) that between Madeira, the Azores, and Bermuda, proceeding westward—the isotherms, to a depth of 400 fathoms, show an increase of temperature in proportion to depth; whilst below that depth there is an evident increase the contrary way to 800 or 900 fathoms. In the next section, that between the Canary Islands and the West Indies, the same development of temperature occurs; but in the last-named section there is a dip to the southward of about eight degrees between the east and west end of the sections. As that is not the case in the somewhat curved line of the first named, and also with the knowledge that the effect of the solar heat is but superficial, the difference in the depth isotherms cannot be attributed to latitude. The depth isotherms on the Equator are nearly equal.

The manner in which the isotherms, between 60 and 40 degrees in the first of the two northern sections, are pressed down or squeezed together by the warm belt on the western side is remarkable, the temperature of 40° being at about the same depth in both sections below the 60° isotherm at 700 fathoms. The temperature relative to depth is similar in an extraordinary degree, and indeed varies so slightly that no conclusions can yet be drawn from them. Immediately the warm belt in the northern section is lost, west of the Azores, the water, which to the westward was pressed down, rises, and occupies exactly the same depth at which it is found in the section taken nearly 1000 miles to the southward. A position about 200 miles west of the Azores seems to be the one most free from currents. About the islands themselves, there are evident indications of local disturbances.

Soon after the warm belt is lost, a broadening of the isotherm between 45° and 55° takes place. As this change agrees so nearly with that found on the coasts of Europe, being water of the same temperature, and occupying the same abnormal depth of 700 fathoms, it is supposed that a connection exists, and that the overflow of the Gulf Stream passing north of the Azores, strikes against the coasts, and *banking down* part of it—having lost 15 degrees of its heat—branches off to the southward, occupies the place of that originally blown to the westward by the trade winds, cooling all the time: for the isotherm of 45° on the southern section is only 550 fathoms from the surface, whilst in the north it is 700 fathoms; the water at that depth is therefore 3 degrees warmer in the north section than in the south.

The temperature of the bottom water varies but little excepting on the west side, where, in the deepest part of the south section, the water is slightly colder than that found elsewhere. On the eastern side of the Atlantic, passing the Azores and Cape de Verde Islands, it is remarkably uniform at 35·2° North-east of this curved line in the Bay of Biscay, the bottom temperature is one degree warmer, and south-

* *Vide* the Report.

ATLANTIC OCEAN.—WEST TO EAST ISOTHERMAL SECTIONS.*

BERMUDA TO AZORES AND MADEIRA.

Position.		Bottom.		Temperature.													Surface Temp.
Lat.	Long.	Depth.	Temp.	34°	35°	36°	37°	38°	39°	40°	45°	50°	55°	60°	65°	70°	75°	
N. ° ′	W. ° ′	fms.	°	fms.	fms.	fms.	fms.	fms.	fms.	fms.	fms.	fms.	fms.	fms.	fms.	fms.	fms.	°
32.54	63.22	2360	35.	...	...	1590	1230	870	750	680	520	450	400	350	110	60	...	74.
34.28	58.56	2575	35.	...	...	1650	1310	920	810	670	500	430	370	300	90	20	...	71.5
34.54	56.38	2850	35.1	...	...	1690	1340	970	790	660	510	440	380	295	80	10	...	71.
35.7	52.32	2875	35.2	...	...	1750	1400	1020	750	650	500	430	360	270	70	...	...	70.
36.33	47.58	2700	35.1	...	...	2110	1430	1100	980	860	600	530	450	330	50	20	...	72.5
37.24	44.14	2750	35.3	...	...	1960	1390	960	830	750	610	520	420	330	40	10	...	70.
37.54	41.44	2700	35.2	...	...	1860	1360	870	740	690	530	470	410	310	60	10	...	70.
38.23	37.21	2200	35.1	...	...	1800	1370	1070	910	750	550	420	340	180	40	10	...	71.
38.18	34.48	1675	35.9	...	...	1600	1110	840	750	650	410	310	200	60	20	...	...	71.
38.34	32.47	1240	37.1	...	...	...	...	1110	880	760	500	320	220	130	10	...	...	71.
38.30	31.14	1000	38.7	...	...	...	...	...	960	840	520	390	270	100	20	...	...	69.
38.11	27.9	900	39.5	...	...	...	...	...	...	890	610	400	130	90	50	...	...	70.
...	...	1000	...	...	...	...	...	...	...	900	620	390	180	60	30	...	...	71.
36.21	23.31	2025	34.8	...	...	...	1320	1150	1000	900	640	380	160	60	40	...	...	71.5
35.3	21.25	2660	35.3	...	...	...	1350	1170	980	900	700	400	150	50	20	...	...	71.
33.46	19.17	2400	35.3	...	..	...	1390	1140	1000	920	750	430	180	90	50	...	...	70.7

WEST INDIES TO CANARY ISLANDS.

18.40	62.56	1420	37.4	...	...	...	...	1080	920	790	490	380	300	220	170	100	...	76.
18.56	59.35	2975	34.8	...	...	1700	1330	1030	870	710	400	310	260	210	160	100	...	75.
19.41	55.13	2650	34.9	...	...	1650	1300	1020	840	710	460	370	280	210	160	110	...	74.
20.7	52.32	2385	35.4	...	...	1660	1290	1030	860	720	470	370	280	210	160	100	...	74.
20.49	48.45	2325	35.1	...	...	1650	1260	1030	890	750	460	360	280	200	140	90	...	72.5
21.38	44.39	1900	35.3	...	...	1610	1210	1010	840	720	500	390	290	210	150	90	...	72.
23.10	38.42	2720	35.4	...	...	1660	1250	1030	890	760	460	350	260	180	130	90	...	72.
23.12	32.56	2700	35.5	...	...	1680	1300	1100	1010	910	520	360	280	190	120	...	...	67.
24.20	24.28	2740	35.6	...	...	1700	1390	1180	1030	930	560	360	250	160	70	...	...	68.
25.28	20.22	2220	...	...	...	1660	1480	1280	1110	990	530	350	240	160	40	...	...	66.
25.52	19.22	1945	35.5	...	...	1640	1410	1220	1090	970	520	330	230	150	90	...	...	67.
27.24	16.55	1890	35.6	...	...	1600	1290	1130	1030	920	580	350	210	130	...	...	...	64.5
Canary Islands		...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	64.

PERNAMBUCO TO FERNANDO NORONHA, ST. PAUL'S ROCKS, AND LONG. 14° 49′ W.

S.																	
7.37	34.12	1650	36.2	...	...	...	1170	690	390	320	230	190	170	120	90	60	20	77.5
5.1	33.50	2275	33.2	2120	1780	1460	1120	770	490	310	220	170	100	60	50	40	20	78.
3.33	32.16	2260	32.9	1990	1760	1580	1300	910	530	350	230	170	100	60	50	40	20	78.
N.																		
0.9	30.18	2275	33.6	2150	1880	1580	1250	910	590	380	240	180	120	90	70	60	50	77.5
1.47	24-26	1850	35.3	...	...	1700	1380	1070	730	430	210	140	90	60	50	40	30	78.8
2.6	22.53	2275	35.2	...	...	1680	1300	1000	710	540	250	160	120	90	50	30	10	78.
2.25	20.1	2500	35.1	...	...	1650	1140	850	660	560	300	190	120	80	60	50	30	78.
2.52	17.0	2475	34.8	...	...	1600	1120	830	630	460	260	180	120	80	60	50	30	77.
3.8	14.49	2450	35.1	...	...	1560	1100	810	600	420	250	170	110	60	50	40	20	78.

SOUTH AMERICA TO TRISTAN DA CUNHA AND CAPE OF GOOD HOPE.

S																	
20.13	35.19	2150	33.1	1880	1530	1180	820	550	450	390	290	210	180	130	90	50	...	74.
26.15	32.56	2350	33.4	2250	1910	1420	580	520	480	440	340	250	190	100	40	...	...	69.
29.35	28.9	2275	33.3	2020	1600	1190	790	560	500	470	330	240	180	110	...	...	...	65.
35.25	23.40	2050	34.	2050	1690	1350	990	650	410	390	290	200	100	...	...	...	..	58.
36.12	12.16	2025	34.9	...	1300	880	520	450	400	380	230	60	...	...	...	...	...	53.5
36.43	7.13 E.	2100	34.	2100	1520	1010	560	450	400	380	280	190	...	...	...	...	...	54.
35.59	1.34	2550	33.2	2250	1730	1190	600	500	450	400	290	220	120	...	...	...	...	56.1
36.22	8.12	2650	33.8	2390	1990	1500	990	500	420	390	280	210	130	...	...	...	...	56.2
35.35	16.9	2325	32.9	1960	1680	1220	500	390	350	320	230	120	40	...	...	...	...	56.2
35.0	17.57	1250	...	...	...	1160	490	380	330	310	220	130	60	...	...	...	...	59.

* From Captain Nares's diagrams of Isothermal lines.

west of the line it is half a degree colder; further south, again, at the Equator, on the western side of the Atlantic, the bottom temperature is 32·4° or 2·8° colder.

There being bottom water of a temperature of 32·4° at the Equator, with warmer water at all the stations north of it, Captain Nares argues that it proves unmistakably that the cold water at the bottom of the Atlantic as far north as the Azores and Bay of Biscay, equally with that at the Equator, is derived from an Antarctic and not from an Arctic source: for if at the Equator the water supplied from the southward retains its cold temperature to so great an extent, the bottom water of the North Atlantic, if supplied from the nearer Arctic sea, should at least be as cold; but the temperature of the lowest stratum increases decidedly as we pass north, and completely cuts off the Arctic water found at the bottom of the Færoe Channel by the 'Porcupine' from that found at the Equator. On the western side of the Atlantic, at all the stations south of the northernmost line, the bottom water is colder than on the eastern side, showing that the Antarctic cold current enters the North Atlantic, and runs to the north-westward through the channels between St. Paul's Rocks and the Brazilian coast, and gradually expends itself as it circles round to the north-eastward, in the same manner as the warm equatorial current does on the surface, considering that current as including the Gulf Stream, which it undoubtedly helps to produce. This cold current entering the North Atlantic is found between 1700 fathoms, and the bottom, a total thickness of 700 fathoms.

In comparing the temperatures of the water at different depths at several stations with that found at the Equator, the alteration is very marked, and may readily be distinguished. The greatest change or disturbance at Sombrero, West Indies, is an increase of heat of from 14 to 15 degrees at a depth of from 100 to 250 fathoms. At Bermuda the maximum rise is 19 degrees, but at the lower depth of from 300 to 650 fathoms: even in the Bay of Biscay the increase is 8 degrees at a depth of from 300 to 500 fathoms.

Thus the heat-giving properties of the equatorial and north-east trade current, carrying as they do a continuous body of warmed water towards the Carribbean Sea, can be traced by the rise in temperature of the whole body of water at Sombrero and afterwards at all the stations in the North Atlantic; but most readily so by the widening of the isotherms about 62° between America and the Azores, forming an immense reservoir of warmed water 1000 feet thick, and at least 2,000,000 square miles in extent. This change of temperature or disturbance is greater and nearer the surface on the western side of the Atlantic (the nearest point to the source of the current) than on the eastern side, where it slowly but gradually expends itself, sinking as it expires.

The most remarkable fall of temperature due to depth was found at a station 180 miles south of Cape Verde Islands, at the south edge of the trade-wind, the temperature at 50 fathoms being 54·2° when the surface was 78°, a fall of 24°.

As a proof of the superficial nature, it was found that when the equatorial current was running to the westward three quarters of a mile an hour at the surface, it was running four-tenths at the depth of 50 fathoms, but at the depth of 75 fathoms there was no current.

The serial temperatures obtained between the American and African coasts vary less than those obtained in the North Atlantic basin. Although the water is much colder than in the northern seas, it is, strange to say, warmer than at the Equator to the westward of St. Paul's Rocks. The coldest water obtained on the western side of the South Atlantic was near the American coast, where it was 33·1° at a depth of 2150 fathoms. Further from the land, and in deeper water, the temperature, which was expected to be colder, was 33·4° at 2350 fathoms; but, as between the stations there was a distance of 350 miles there was quite sufficient space between them to contain a cold-feeding current running to the northward.

The bottom water near Tristan da Cunha, midway between the continent, is 1 degree warmer than that nearer the land on either side. At a distance of 130 miles a temperature of 32·9° was found at a depth of 2325 fathoms.

Taking the water at the Equator, west of St. Paul's Rocks, below 100 fathoms as being the least disturbed, and therefore the best for comparison, the water between 50 and 400 fathoms at each of the stations between the Brazilian coast and Tristan da Cunha is found to be warmer than the equatorial water. This is accounted for by the reasoning that the Brazilian branch of the equatorial current curves to the southward and the southern part of the south-east trade-wind current banks up and collects the warmed water in that part of the sea. To the eastward of Tristan da Cunha the difference becomes gradually less, until at 300 miles westward of the Cape of Good Hope the water is colder at all depths down to 1500 fathoms, after which it is much the same until near the bottom, where it is half a degree warmer than at the Equator.

The table of latitudinal isotherms* (see Table of North and South Isothermal Section), deduced from the four lines of longitudinal isotherms, will prove interesting in showing the action of the cold Antarctic water in its flow north. In the northern lines are seen the breadth to which the warmer stratum of water extends—how they are compressed towards the Equator,—how they expand again in the south, though not to so great a degree as in the north, the cold Polar water coming near the surface—and how progressive the thickness of the cold water, say below 40°, increases from the Sombrero and Canary Island line towards the south.

The first indication of the warm surface Agulhas current was found 380 miles west of the Cape, where the temperature of the water was 60°, this being 4 degrees higher than that registered on the previous or succeeding days, the current, indicated by the difference in the position of the ship by dead reckoning and astronomical observation, being 25 miles northerly in the twenty-four hours; part of this being probably due to the prevailing strong southerly winds. The actual stream, or branch, running to the northward on the western side of the Cape was not entered until in shallow soundings, and only 21 miles from the land, when the temperature of the surface water rose from 58° to 62°. Five miles

* The course of these sections are inserted on the contour chart.

ATLANTIC OCEAN.—NORTH TO SOUTH ISOTHERMAL SECTIONS.

WESTERN SIDE.

Position.		Bottom.		Temperature.														Surface Temp.
Lat.	Long.	Depth.	Temp.	34°	35°	36°	37°	38°	39°	40°	45°	50°	55°	60°	65°	70°	75°	
N. ° ′	W. ° ′	fms.	°	fms.	fms.	fms.	fms.	fms.	fms.	fms.	fms.	fms.	fms.	fms.	fms.	fms.	fms.	°
34.54	56.38	2850	35.1	...	...	1690	1340	970	790	660	510	440	380	295	80	10	...	71.
19.15	57.47	3000	34.4	...	...	1690	1320	1010	850	700	410	320	250	200	150	90	..	75.
S 1.45	30.58	2475	32.4	2070	1810	1560	1260	910	660	360	210	160	100	60	50	40	30	78.
26.15	32.56	2350	33.4	2350	1910	1420	580	520	480	440	340	250	190	100	40	...	...	69.

EASTERN SIDE.

N *37.54	41.44	2700	35.2	...	...	1850	1340	860	710	680	520	460	390	290	40	10	...	70.*
*35.3	21.25	2660	35.3	...	...	2090	1340	1160	970	880	700	390	130	40	20	...	...	71.*
23.23	35.11	3150	35.4	...	...	1680	1280	1090	960	830	490	360	260	180	120	20	...	72.
2.6	22.53	2275	35.2	...	...	1670	1280	980	700	520	220	150	100	70	50	30	10	78.
S 35.59	E 1.34	2550	33.2	2240	1730	1190	600	500	450	400	290	220	120	...	...	...	...	56.1

* Either of these two positions can ba used with the observations that follow them.

nearer the land a serial-temperature observation proved that the water was affected to 90 fathoms, the temperature being raised 3.5°

An extended series of observations are required to ascertain the cause of the stoppage or turning of the Agulhas current. The observations of the 'Challenger' indicate that the broad and comparatively sluggish South Atlantic drift-current, running to the eastward before the continuous westerly winds, accumulates its water against the West Coast of Africa, raising the level of the sea sufficiently to prevent the Agulhas current continuing its course, and swallows or diverts nearly the whole of it, a very small portion escaping to the northward round the Cape during the southerly winds, intermixing with the colder water of the drift current, which also throws out an offshoot to the northward as it strikes against and meets the African coast and Agulhas stream. Great variations in temperature may naturally be looked for when two such oppositely constituted currents meet and intermingle. It is well known at the Cape of Good Hope, that the warm current seldom extends as far to the north as Table Bay, the water there being much colder than in Simon's Bay.

During the stay of the 'Challenger' in Simon's Bay, the wind was blowing nearly continuously from the south-east, and the temperature of the sea was from 62° to 64°, the same temperature, and therefore water derived from the same source, as was found outside close to land; but on one occasion this warm water was driven out of the bay by a north-westerly gale, and replaced in about six hours by water of a temperature of 51°. This applied not only to the surface water, but to that at the depth of 9 fathoms, in which water the ship was anchored, and to which the observations extended. The current usually circles round the bay from Cape Agulhas to Cape Point; on this occasion, whilst the water was gradually cooling, a current was circling round the bay in the opposite direction, running to the eastward from Cape Point towards Cape Agulhas.

From this the inference is drawn, that during north-westerly gales the pressure of the wind is sufficient to overpower and drive the narrow branch or horn of the Agulhas current, which at other times is found touching the Cape, to the southward with the rest of the stream. Immediately the pressure from the north-westerly wind is withdrawn, and the water in the bay increases in temperature, it indicates the return of the warm Agulhas stream.

It is remarkable that the surface water, of a temperature of 51°, found in Simon's Bay during the north-westerly gale was colder than that found at any station to the westward during the passage across the ocean except at a depth of 50 fathoms; the lowest surface temperature being 54°.

Again, when passing out of Simon's Bay, a cold belt of water was entered, and in the distance of 5 miles the temperature of the water had fallen 9° —or from 64°, at the anchorage, to 55°. This was found to extend 10 miles off the Cape; it then rose again to 65° and 66°. This cold water is evidently a spur of the Atlantic easterly drift-current forcing its way into the warmer water of the Agulhas current; or rather, the Agulhas warm current overrunning and spreading itself out above the colder water of the Atlantic drift, the dividing line being very marked. Ten miles further to the southward, warm water was found extending to a depth of 50 fathoms.

When at a distance of 100 miles south of Cape Agulhas, the temperature of the water suddenly rose from 67° to 72°, proving that the warmest part of the current had not reached Simon's Bay during the stay of the ship.

The 'Challenger,' having been thoroughly refitted, and due preparation made for the weather she was likely to experience in the Antarctic seas—having also filled up the vacancies in the crew, including that of the photographer, who, either tired of his profession in the Royal Engineers, or lured to the diamond-fields to make his fortune in a more inglorious way, had caused himself to be "absent without leave" too long, —and a cargo of treasures in the shape of cases of natural history collections having been transhipped for England, the kind, hospitable people of the Cape said "good-bye" to, sailed on the 17th of December

1873, from Simon's Bay, the weather beautifully fine, and all hands full of life and spirits at the prospect of again getting into a temperate climate—and, it may be added,—visiting places of which but little is known.

A sounding was taken in the afternoon. In 98 fathoms green, sandy mud the dredge was lowered, and a quantity of star-fishes, shells, hermit-crabs, coral, &c., brought up. The Agulhas current was entered on the 19th, 80 miles to the southward of the Cape. The breadth of the stream was about 250 miles, and it was found to affect the temperature to a depth of about 400 fathoms. A sounding was taken in 1900 fathoms, and serial-temperatures taken at every 10 to 100 fathoms, and at every 100 to 400 fathoms; specimens of water were also obtained from 50, 100, 200, 300 and 400 fathoms. The dredge was put over with 2600 fathoms of rope.

The weather and a heavy sea prevented a more extensive examination of the Agulhas stream, which so much influences the climate of the Cape of Good Hope. This great body of heated water, similar to the Gulf Stream, is driven to the westward from the Indian Ocean by the combined action of the north-east monsoon and the south-east trade winds; and on reaching the longitude of the Cape, it is met by the cold drift current of the Atlantic, caused by the continuous westerly winds of the higher latitudes, and forced back to the south-east and eastward, at one time the warm stream prevailing, at another the cold, according to the prevalence and force of the wind.

The usual strong westerly gales of these latitudes were experienced as the ship ran before it towards Prince Edward Islands, and the usual albatross and Cape hen kept company, as if in satire, to wish the voyagers a Merry Christmas. On the eve of that day a yellow-crested penguin suddenly rose alongside the ship and hailed her in its inharmonious croak or bark, and then as suddenly dived out of sight. The weather was thick and drizzling, and Christmas Day was spent under anything but agreeable circumstances; but, as in the preceding one, doubtless many a thought was sent to the loved ones at home, and as many thoughts sent back, with as full knowledge of their nature in the hearts of the sender and receiver as if the insulated wire had conveyed it. The weather cleared up in the evening, and Marion Island seen, and shortly after Prince Edward Island—the peaks of both being shrouded in mist.

These two islands are supposed to be the *Denia* and *Marseveen* of Van Kuelen, but they were placed so much out in position as to render it doubtful. The first discovery is accorded to Marion du Fresne, in 1772, then in command of a French expedition in search of a southern continent supposed to exist, and which from the size of the island, as seen through the haze, he believed it to be, and named it Terre d'Espérance; but he was undeceived the next day. Both of his ships struck on the rocks, and were nearly wrecked. He also discovered the Crozets, named after one of his officers.

Before the particulars relating to the discovery had been published, Captain Cook, then on his last memorable voyage four years after, also discovered them, and named them Prince Edward Islands; subsequently the northern one retained that name, whilst to the southern was accorded the name of the original discoverer. It is a strange coincidence, that while Cook fell a victim to the natives of the Sandwich Isles, Marion was massacred by the natives of New Zealand.

Marion Island is about 35 miles in circumference, and rises 4200 feet above the sea, the high land being completely covered with snow to within about 1000 feet above the sea; the summit is about 4 miles in diameter, and has the appearance from the north of a series of rugged nipples. The land slopes to the shore in a steep incline on three sides, the fourth sloping more gradually, and terminating in a steep, low cliff. On the inclines are numerous extinct craters, some with the red volcanic ashes round them. The sides of the hills are thickly studded with lava boulders, cropping out through the boggy vegetation.

Prince Edward Island is not so large as Marion, being only about 15 miles in circumference; it lies 13 miles north-eastward from Marion. On its eastern side is Cove Bay, in which, at times, vessels anchor.

The next day, the weather being moderately fine, the ship was steered for Marion Island. Having passed the north end of the island within 1½ miles of Prince Rock, which resembled a boot in shape, a small portion of the coast on the lee side appeared to have less break of the surf than the rest. The ship was steered in towards it, and a boat despatched to ascertain if it was possible to land; the report being in the affirmative, the ship *hove to* about half-a-mile from the shore—the incline being too steep to anchor—and exploring parties at once landed. While these were engaged gathering anything and everything they could lay their hands on, the ship stood off and on between the islands, ransacking the bottom of the sea by dredging. Fortunately the weather was fine enough to enable astronomical observations to be taken.

The ground rises from the shore to the summit in a series of long spurs separated by gullies, down which streams of water poured from the melting snow above. The shore was a scene of grand desolation—bold rock with beaches of huge boulders in all shapes, and so slippery from the half-dried kelp, as to require much caution in leaping from one to another. Abundance of kelp lined the shore in the water, and innumerable penguins the land. The hill-side was covered by a mixture of moss and grass, so saturated with water that walking through it resembled wading through a bog.

The Kerguelen cabbage was found in great abundance, and proved very palatable when boiled, notwithstanding its slightly medicinal flavour. But the great feature was the number of nests, described as a perfect bird-warren, for while the petrels and small birds placed their nests in the hollows of the ground, under the large tufts of moss, the larger albatross covered the higher ground in nests raised about 2 feet above the ground, clear of the moisture, and in such numbers that they looked like a flock of sheep. Most of them were roosting, and took no notice whatever of the invaders of their soil. It was evident that the breeding season was only commenced, as but few eggs were obtainable.

The albatross, although one of the most graceful birds in creation when on the wing, swimming with such stateliness through the air, or rising and falling with the mountain waves of the southern sea, is but an awkward animal on *terra firma*. Its walk is a very waddle, and having no idea of hovering to alight,

it often fails in the attempt; or, if it succeeds, comes with such a flop and impetus to the ground that it topples over on its head, at times making a complete somersault; sometimes it gets completely on its back, and has great difficulty to regain its feet. To rise from the ground, they run for some distance with extended wings, until they obtain an impetus sufficient to float them in the air; but once landed they are powerless to resist attack. A sharp snap with the beak is their only mode of defence, although that snap will produce a good wound on unprotected flesh. To obtain its egg a push with a stick on the breast of the poised bird, as she sits on the side of the nest, is sufficient to send it sprawling on its back, and before it can regain its upright position the prize egg is gone, and the wail of the despoiled mother, as she perches again on her rifled nest, tells the tale of her woe.*

Three kinds of penguins were found on the island, viz., the king penguin, a black and white one without crest, and the small yellow crested kind, similar to that found at Tristan da Cunha. The breeding season of these animals was nearly over, but some eggs were found unhatched. The king penguin makes no regular nest; but, if disturbed, carries its egg between its legs in a fold of the skin under the belly, and again sits where it stops. The sheath-bill, a land bird, follows the poor penguin with its egg most pertinaciously, to seize it at any unguarded moment.

Hoping that the weather might continue favourable, and enable a party to land on Prince Edward Island the next morning, the ship was *hove to* for the night; but the morning proved misty, and heavy clouds covered the island, which compelled Captain Nares to relinquish his intention and proceed at once towards the Crozets. Several rich hauls with the dredge were obtained before making sail.

On the 29th, when 200 miles from the Crozets, soundings were obtained in 1375 fathoms white ooze, and the trawl was let down with much success, bringing up many new specimens, including cuttle-fish, Venus's flower-basket, &c. Whilst sounding, four penguins came up suddenly, and having conversed with each other, disappeared. The next day 1600 fathoms was found when 86 miles from Hog Island: a serial temperature was obtained. Hog Island, the westernmost of the Crozets, was sighted in the evening, soon after ten o'clock.

The morning proved unfavourable for approaching the island—a wet fog; it lifted a little in the afternoon, but the mist did not rise from the land, and, on approaching, nothing but the breakers on the shore could be seen. In the evening the dim outline of the Penguin Islands was seen through the mist. Both islands rise abruptly from the sea, the summits appearing as sharp pinnacles rising suddenly from above the high land.

The new year set in with the same misty weather, and there being no probability of landing or even correcting the charts. On the afternoon of the 2nd the ship was steered for Possession Island, the middle island of the group, and the voyagers were rewarded by a fine view both of Possession and East Islands, the former rising in two peaks nearly 5000 feet above the sea.

As before remarked, the Crozets were originally discovered by Captain Marion du Fresne, and afterwards seen by Cook. The group consists of five islands, of which Possession Island is the largest. They were surveyed by Captain Cecille in the French frigate 'l'Heroine,' but such is the nature of the climate, and so constant the gales and fogs, that although several weeks in the vicinity, they were but imperfectly surveyed after all. Captain James Clark Ross, in the 'Erebus,' visited the islands in April 1840, and as he had received on board some provisions for a party of sealers on Possession Island, and also having appointed the island as a rendezvous for his consort the 'Terror,' from which ship he had parted company, he had two reasons for wishing to communicate with the island.

They first made Hog and Inaccessible (or Penguin) Islands, the last most appropriately named, having steep and perpendicular rugged cliffs in every fantastic shape, and from which the imagination could easily form ruins of castles, cathedrals, &c., heaped one above another, the picture of desolation; not a particle of verdure to be seen, but plenty of animal life in the myriads of penguins which occupied the ridges, like soldiers in line, wherever there was footing for them. The 'Erebus' ran quickly past the island, hoping to make Possession Island before dark; but not doing so, the ship was hove to for the night. It was not till three days after that the ship could be got in with the land. Guns were fired to attract attention, which were soon answered by a fire on the shore; but the ship was too far to leeward for a boat to venture off. As is often the case in these latitudes, the wind increased rapidly to a gale, and the ship was obliged to stand off again. The next day they again hoped to communicate, but it fell quite calm with the ship 5 miles from the shore. On the 1st of May, Captain Ross succeeded in getting off American Bay, and a boat was soon launched and came out from the shore. Of course great curiosity was felt to see the men who could be induced to live on such a place. The establishment consisting of about a dozen men employed by a Mr. Jerry, a merchant of Capetown. The boat, with six men, was soon alongside; one of the men, Mr. Hickley, being in charge of the establishment. They were fine, hardy-looking fellows, but abominably dirty. They did not ask for news, or even where the ship was going, but only seemed disappointed that the ship was not going to take them to the Cape. When they were told that stores for them were on board, sent by their employer at the Cape, they evinced no interest about them; and even when Captain Ross gave them a gallon of rum, they seemed to accept it as a trifle scarcely worth thanks. They had seen the ship for two days, but had seen none other, saving an American whaler two months before. Mr. Hickley informed them that they captured a large number of sea elephants, the tongue and flippers of which they eat; they also catch a considerable quantity of a species of rock cod, which is salted down. The eggs of the sea birds can be obtained in any quantity, and the young of the albatross, when taken from the nest, is considered a delicacy. During the summer months they visit Pig

* The action of these birds is sometimes most ludicrous. The author has observed three standing at points of a triangle on a cliff, with out-stretched necks towards each other, and as if in deep and earnest conversation. One would, as it were, lay down the law, moving its head up and down, whilst the others listened with heads on one side; and when the speaker had finished, another commenced. This lasted for upwards of an hour while they were watched. Of course when they commenced or when they left off could not be known.

Island for the purpose of killing pigs, which abound in large droves; the pork is salted down for their subsistence on the island, and for provisions in going to and from the Cape. Many goats exist on Possession Island, and wild ducks in great abundance.

When the stores were in the boat, and the men were told by Captain Ross that he wanted to make sail and wish them good bye, they, without any expression of regret or interest, went into their boat and pulled off. It was remarkable to see men shut out from the world so long, so utterly devoid of curiosity, and it caused some reflection as to how soon a man may degenerate into the savage. They have no females, or anything to render life tolerable, and they seemed to be losing the powers of conversation, for it was with difficulty anything could be extracted from them.

On the 'Challenger' approaching the south-east end of the island, it was noticed that the sun was shining on it continuously, and the ship passed gradually out of the fog, leaving it as a wall behind them, into clear weather, with scarcely a cloud to be seen overhead. To the northward the fog was as thick as that sailed out of, and the peaks of East Island, situated to leeward of Possession Island, as the wind then was, showed themselves above a dense bank of white fog-cloud, thus proving that the lofty hills of Possession Island had the property of dispersing the fog as it passed, so that whilst the weather side of the island was enveloped in mist, the lee side was perfectly free from it. In connection with this circumstance, it was noticed that there were no albatross nests on the misty side of the island, whereas the clear part was thick with them. One fact in regard to Possession Island was curious, viz., that although 1000 feet higher than Marion Island, it was nearly free from snow, whilst the latter was entirely covered with it.

The 'Challenger' steamed to within half a mile of Navire Bay, and seeing a hut at the bottom of the bay, with what appeared to be a boat and some casks near it, the ship stood in, and fired a gun to attract attention, but after waiting some time, and seeing no sign of life about the hut, she stood to the northward towards America Bay. On opening the north-east coast a swell was found from the northward, rendering it unsafe to anchor, and the 'Challenger' proceeded on her way towards Kerguelen Island.

On the 6th of January Bligh's Cap was sighted, and the next morning the 'Challenger' anchored in Christmas Harbour.

J. E. DAVIS.

SIGN-POSTS ON OCEAN'S HIGHWAY.

II.

BASALT—*Continued.*

WE now come to outbursts, upheavals, and overspreading molten matter; to these we join subsidencies. None of these actions are directly related to the origin of basalt, but all of them are directly related to the varied conditions in which this rock appears before us. It is allowed on all sides that basaltic formations must once have been in a pasty or a fluid condition. We are told that the hard schists were deposited as mud or silt. If the silicious materials, of which these schists are composed, were capable of being converted into mud, how much more easy must it have been to make muds out of these schists, when it came to their turn to be reconverted into solutions, to mix with the increasing soft materials, all ready to form another mud. Mud has not been an attractive subject, our science gets rid of it as soon as possible, yet the phenomena connected with it are very numerous, very interesting, and all-important to our present subject. On looking along our sea shores we find frequent subsidencies of upper earth-masses into the soft mud or gault below. This gault is pressed or injected into the fissures of the subsiding mass, it is forced into the shape of pillars and dykes, and it is squeezed down through the ordinary water-runs beneath the sands, where we find it as thin interstratifying sheets. When the overlying sand is incapable of resisting the force of the pressure, it is forced up into banks or ridges, parallel to the line of subsidence. If the muds of to-day are liable to these actions, there is no reason why the muds of old should not have been under the same law. There may be differences in the constitution of the mud, or of the overlying and subsiding strata; but the law of gravitation is the same; so that if the mud or silt is unequal to sustain the weight of any overlying matter, then that matter must of necessity subside into the mud.

Subsidencies therefore do take place; they do force liquid, or plastic mud into overspreading sheets; they produce upheavals and outbursts of the mud into every possible shape allowed by surrounding matters. To this unavoidable system we owe the convulsions, the fractures, and the condition of many of our mountain masses. The cessation of volcanic action during the old red sandstone system was purely imaginative on the part of Mr. Page, but it will be obvious to any one, that when sand was in course of deposit, mud could not be; so that the subsidencies and their results did not take place. We will not be so dogmatic as to say that the Giant's Causeway is due to cold mud and pressure; there are many similar formations about the world, and if we allow that basalt ever was in a plastic state, there is no reason why it should not have assumed the columnar and prismatic form under a cold as well as under a molten condition. The crystalline condition of these columnar basalts has been brought forward as proof of igneous action. We have given good reasons why basalt, as it is, could never have been in a molten condition, and we believe that crystallization is only a proof of the presence of silex. Perhaps no experiment was more absurd than that by Sir James Hall, who sealed up his pounded chalk to prevent the escape of gases, and then exposing it to heat converted it into crystallized marble. He ought to have known that natural strata have no hermetical seals, so that his experiment was no criterion of natural action. It is a well-known fact that basaltic lava retains its heat longer than other lavas, but it has been a matter of wonder how molten basalt could have retained its fluidity, so as to run over many hundred square miles. We do not suppose that the great basalt sheets of America or of India ever were molten; but if they were formed of mud, then there is no limit to their extent, so long as the supply was under the law of gravitation.

Having thus briefly vindicated the law of gravitation, we have now to consider the results of contact between certain rocks. Hutton jumped to his conclusions because he wanted them; he had formed his theory

before he went to the Grampian Hills, and he assumed that veins of one rock permeating another gave evidence of a melting process. No one has explained how this permeating action was carried on, and we are at a loss to understand how a soft molten matter could run into an unmolten rock. There is nothing in the laws of nature whereby we can solve this point; but there is a law under which the whole process is done without fire, and in default of any fire examples we may fairly assume that the granitic veins of Hutton were formed in the same way.

It is a very common occurrence in the fine sandy formations of eastern rivers to find veins of one colour and one character running into masses of other characters and colours; the heavier muds run into their lighter neighbours, assuming every variety of figure. The same results may be seen in English clays. Marbles are evidences of the same thing; so that, under these actions of the laws of affinity and gravitation, Mr. Hutton's veins required nothing out of the way to place them where he found them. On looking at calcareous rocks in many parts of the world, at slates and schists, we have seen that the silicious matter frequently runs from one part to another. In the Isle of Wight great masses may be found into which these percolations have taken place; by which portions have become so indurated as to withstand the ordinary denudating causes, and remain as hard rock after the destruction of that portion from which its silicious matter came. The same action is evident in the schists, where the silicious matter has run from one part into another, forming veins in one portion, and crystallized blocks in another. These are only different results of the same law exhibited in chalk, where the silex percolates from the sediment, forming a layer of itself: as no one supposes this is done by heat, so there is no proof that heat does the others. Fire is not needed for the petrifaction of wood, for the conversion of sponge into flint, or for the formation of agate: they are all cosmical alterations of matter due to the laws of affinity and gravitation. As fire is not wanted for the alteration of rocks, for subsidencies, or upheavals, for injections, squeezings, or contractions, or wrinkles, though it may lend a hand to each, or to all, we have now to show how true igneous rocks, such as lava, are connected with fire.

We have strolled on towards the carriage entrance of the gardens. Wide verandahs occupy both sides, their walls are covered with bold frescoes of extinct volcanos. Auvergne and the Venetian Alps are there, with no more fuel to keep up their once volcanic energy. The depths of the supposed fires are exhibited, according to fancy, as eight miles deep, twenty-five, thirty, one hundred, two or three hundred, two thousand five hundred, and the precession of the equinoxes goes on, without any reference to these diverse conditions, with its ordinary regularity. We think of the bold paintings of the infernal regions on Italian cupolas by artists dreaming of Dante or of Virgil. We see that the world goes on in its goodness and its wickedness just as it did before Virgil or Dante lived, and we recollect that no poesy, no philosophy can alter the laws of Heaven or of earth. In a dusty corner we find a design of Sir Humphrey Davy busy with potassium and sodium, his attendants are loading a van with alkalis; the coachman is ready to drive it round the world, to show the causes of subterranean heat and volcanic action. "Silica, alumina, lime, soda, and oxide of iron, substances of which lavas are composed," were all packed as evidence of the action, but, at the last moment, Sir Humphrey found that the horse "Hydrogen" would not come out of the Vesuvian stable. The team was incomplete, dust was thrown over the van, which became neglected in the corner. It is, however, shown that M. Abich "clearly detected the flame of hydrogen in the eruption of Vesuvius in 1834"; but Sir Charles Lyell had thrown a veil over the van and its load. If it had been brought out then, it would have caused much inconvenience; there were a great many emblazoned chariots and fiery steeds on sale, or likely to be on sale about that time; so, not content with the veil, Sir Charles borrowed a patent break from M. Foquè, who was "satisfied with the hypothesis of a subterranean sheet of fluid lava, to which water may occasionally gain access, central heat being invoked as the power by which the lower parts of the earth's crust are retained in a melted state," and who considered the quantity of "alkaline metals beneath all the active volcanos, which had given rise in each to a long series of eruptions, would be incredibly great." M. Foquè had had the audacity to measure by human finite figures the infinite results of laws which rule this globe; he put down the quantity of sodium required as at least "7,000,000 cubic metres." With the help of this patent break the chemical van was immovable; Sir Charles in his mechanical light phæton got to the bottom of the Andes, and other places of active volcanity first; he found that the existence of fused lava "cannot be doubted," so that his wheels have revolved well up to this time. We now consult him and others about the incredible quantity of sodium.

"Sodium exists in great quantities in the mineral kingdom..... Enormous deposits are found in England, Poland, and elsewhere"; it is "the leading saline ingredient of the waters of salt lakes and of the ocean." If it exists in places we know of, we may give other parts of the earth credit for containing some of it. Sir Charles Lyell tells us that "140,000,000 yards of lava were ejected from Etna in 1669; but this quantity was not equal to one-fifth of the sedimentary matter which is carried down in a single year by the Ganges." Can any one estimate the quantity of sodium carried down in one year from the animal fluids poured into this river from its populous banks? Again he says, "51,321,600 cubic feet of earth are carried off by the sea yearly from Holderness," and "one characteristic of the action of currents is, the immense extent over which they may be the means of diffusing homogeneous mixtures." There is no area of land that does not contribute to rivers some of the rain which falls on it. Sodium is perpetually increasing: it is impossible to estimate the quantity of it contained in the vast masses of earth yearly handed over to the sea, to compute the quantities passed to the ocean by rivers, or to calculate the places where the currents will gather the sodium together as sedimentary matter in the ocean. We are obliged to Sir Charles for enabling us to say that M. Foquè's "incredible," as applied to the results of natural laws, only stamps his followers with credulity; while if we depended on sodium only as the chemical cause of volcanic energy, we should be depending on a source of matter which is

beyond the reach of measurement or of computation, and consequently capable of producing such results as naturally depend upon it.

We have shown above, that in the recent or post-tertiary system all the volcanic products are lava; in the tertiary nearly all are of true volcanic origin; below these no lava is found till the silurian system is reached, while below that there is none. As the chemical causes for the production of fire and heat within the earth must be constantly increasing with vegetable and animal increase, we may say that the situation of lava in the subterranean regions is a *primâ facie* evidence that it was not melted by heat coming from below the sedimentary schists; while the present situation of lava on the surface is a proof that the heat is caused by chemical action in the deposits of the earth. So that No. 26 may be a true picture, and No. 9 may have a greater range than Mr. Woodward supposes. We have, however, something more to say of local heat before we can say that the theory of Sir Humphrey Davy is an absolute certainty.

Passing back by the other side of the gallery, we find some interesting sketches taken by Sir Charles Lyell, whilst travelling in his light phæton over the very causeway on which he thought it necessary for Sir Humphrey to use the skid.

(No. 42.) Hot springs are important to geologists, for the "quantity and quality" of the earthy materials thrown up.

These materials are—

(No. 43.) "Carbonic, sulphuric, and hydrochloric acids, combined with bases of lime, magnesia, alumina; and iron, chloride of sodium, silica, and free carbonic acid, as well as nitrogen, are commonly present."

We cannot help wishing that Sir Charles had devoted a little more time to these quantities and qualities, for it must have struck him as strange, that waters having fallen in with one heating cause, in some unknown place, should fall in with another before reaching the surface; but Sir Charles had no hesitation, he drove on—

(No. 44.) "When new combinations take place, some of the gaseous, earthy or metallic ingredients of the springs may be intercepted in their upward course."

We consider this picture and No. 9 to be of the same school; and we venture to place the artists among the first philosophers of our times, in finding out that water became heated in subterranean regions by an unknown cause, before it ran up hill, on purpose to find a well-known cause of heat. We do not quite understand what is meant in this picture by "new combinations;" some must be for ever forming; but we have no occasion for them while old combinations produce hot water.

(No. 45.) Hot water is abundant "in regions where volcanic eruptions still occur."

The scene is true to life: the mountain vomits spasmodically; the hot water runs out constantly; it is assumed that the igneous causes are the same for both. The volcano dies away, the spring runs on; the origin of heat cannot be from the same place, because if one died so would the other; but as both fires were fed from the surrounding strata it follows that the slow eroding water has not used up its supply, while the fiercely eroding volcanic fire has used up all the igneous causes available to it. We find as we wander back some little sketches that will make the subject comprehensible.

(No. 46.) "The mineral springs of Cauquenes burst forth on a line of dislocation, crossing a mass of stratified rock, the whole of which betrays the action of heat."—*C. Darwin.*

The character of this rock is not given, but heat is shown to be in the region—

(No. 47.) "Two springs a few yards apart with different temperatures, the lowest with scarcely any mineral taste."—*Ibid.*

The taste is some proof of heating cause, so that the less mineral, the less heat; but

(No. 48.) "In both these springs—in summer the water is hotter and more plentiful than in the winter."—*Ibid.*

Darwin pondered over this unavoidable result of a natural law, till he found that

(No. 49.) It "can only be accounted for by the melting of the snow . . . . on a range of snowy mountains three or four leagues distant."

It was considered "a very curious" phenomenon, and taking it as he painted it there can be no doubt of its curiosity, or of its philosophic character—

(No. 50.) "We must suppose the snow water, being conducted through porous strata to the regions of heat, is again thrown up to the surface by the line of dislocated and injected rocks at Cauquenes, and the regularity of the phenomenon would seem to indicate that in this district heated rock occurred at a depth not very great."

As far as nature is concerned, the phenomenon seems simple and beautiful. The melted snow percolating the earth finds in it causes of heat, and its level through the Cauquenes stratified rocks, which betray the action of heat. As there is no melting snow in winter there is a smaller issue of water, as its subterranean erosion is not so great as in summer, the mineral taste is reduced as well as the heat. The only curious part of the phenomenon is that the naturalist of the 'Beagle' should have imagined any necessity for "thrown up water," when he saw that it was running down from the mountains. We look into our own pocket-book for a similar case—

(No. 51.) At Wuzerebai, near Tanna, Bombay, a number of hot springs, of varied temperature, rise by the side of or in the river bed: when the river is clear, these springs are clear; when the river is muddy, the hot springs are muddy.

The river waters find access to igneous matter on levels above these springs, that is, they run through strata containing the alkali of No. 9, or the metallic ingredients of No. 44, issuing from their different springs at temperatures due to the varied strength of the igneous causes they met with, or to the distances from the source at which they met them.

If we now look at the chemical theory of heat suggested by Sir Humphrey Davy—if we accept No. 40 as evidence against a molten condition of the interior, No. 26, as a dogma against the existence of

primeval volcanoes—if we consider No. 44 and No. 9, we shall comprehend that the production of heat in the earth does not depend on depth, but on causes which may exist in any strata, as allowed by opponents of the chemical theory. There can be no error in this theory; there is no break in the system since it first began; it is conducted by natural laws from which there is no escape; its action is universal, but never similar. A great deal might be said here on the combination or constitution of bodies as well as on atomic theories. The subjects would lead us into boundless worlds, while all we wish to impress is, that whatever deductions we make from pictures or from facts are made on long consideration of nature's laws. They are all cosmical; their results are unavoidable, as every result must be emanating from laws formed by one Almighty Ruler. Man with his finite capacity has been unable to measure God's infinity; the for-ever-varying quantities and qualities of matter are not understood; Baron Richthofen has slightly touched upon them, but the subject is almost too extensive for one lifetime to see. Man cannot estimate the heating causes in his own body; he does not comprehend its wondrous chemical changes. Failing in these, it need not be wondered at that he denies to his mother earth the very qualities she has bestowed on him. We are fond of the miraculous and the unseen; the savage adopts his fetish as a god, and we, in seeking for causes of heat in this earth, have adopted the most prodigious theories. Our geological school began its career with caution and observation for its watchwords. We walk through our gas-lit streets, we sit by our warm fires, we travel round the world by the aid of igneous action, gases explode in our mines, cargoes ignite in our ships, we strike a light from the flint, we create heat by the mixture of water and matter, we ignite air by pressure; all of these are results of cosmical laws—the heat and the cold, the air and the water are never forgotten, never lost; something of everything that ever was is in the earth beneath our feet; the sunshine and the atmosphere are buried there, and while we daily use them, our schools have built up great structures from causes which they have not observed. If they wish to retain the confidence of the thinking part of the great communities around them they must reconsider the cause of heat i nthe earth.

We have wandered through long galleries of fair pictures, and notable sign-posts; each finger has pointed out its own path, every picture has represented the mind of its author as truly as the Holy Families represent the minds of Raphael and Sarto. It was not too great an undertaking for them to portray their comprehensions of heavenly gifts, it has not been too heavy a task for others to give us their interpretations of the universal laws; we may admire the pen as much as we do the pencil, but while we look at the pictures we have noted our thoughts run back to the sunshine of our oracular Brahmin.

The air, the rain, and the sunshine have formed these rocks; the glisten of the silex tells of the pure beginning, the dark materials tell of the impurities it has mixed with. We can trace the pure matter from the silicious schists of the early days into the covering of the diatom and into the blade of grass; it is the cement and the girder of this earth, it saturates the sponge and the wood, it mixes with all matter, it percolates through the hard rock, and runs through the cretaceous formations; it is hard, it is gelatinous; in early days it formed rocks with scanty mixtures, in later days it became scantier itself; but with all the impurities mixed with it basalt still holds some 50 per cent. of silex. These cosmical labours of mixing and reconstructing have been carried on in one unbroken chain, formed of most minute links from the beginning; in the midst of them our basalt tor and peaked spire, the mountain range and overspreading masses, the prismatic column vertical and horizontal, the dykes and blocky surfaces stand up before us as the sign-posts by the side of ocean's highway, self-evident proofs of a mud origin, self-evident contradictions of a fire origin, but containing in them such well digested matter that it can only be read by the context, as the tree is known by its fruit.

There is nothing new, nothing wonderful, but there is something very venerable in the subject before us. We fall in with a perpetual resurrection of old matter, the farther we look back the more pure it becomes, buried air and buried rain, bright silex, each at work, great examples of never-ceasing labour, all constituting the earth and the waters in the earth; the whole carrying out the orders of the universal Lawgiver; all so long at work, that wrinkles have been left on our fair mother's brow, formed by the sinking of soft matter by the side of the harder matter. These have remained as they are, evidence of the labour; those have been reconverted into mud for future construction. In these constructions there must be increasing causes of local heat; in the cosmical labours there must be subsidencies and risings—the latter cannot be higher than the former can sink. This part of the subject belongs to our mountain formation, we have used it only so far as it helped on our origin of basalt.

Well may the clear-sighted Werner have declared that basalts were precipitates from water; bravely and truly may he have said, in the face of opposing philosophy, that in the primeval world there were no volcanoes. The unwilling Hutton and many others have unknowingly given evidence of the truth of this much-abused dogma. Their sedimental schists rest on the face of what they supposed to be a fire globe; a globe supposed to be now in a cooling state. If in this condition it is still hot enough to keep up old and to create new volcanic energy, how much hotter must it have been when these schists were deposited by water a few million of years ago, with nothing between them and the seething interior? Yet these silicious rocks were not converted into lava, neither were their earthy impurities separated from them. This separation of matter from the molten lava is now the great criterion of melted silicious rock,* and the lava is the only true result of the volcanic energy. If basalt was ever erupted as a molten matter, why is it not erupted now?

In thus connecting lava with local fires of chemical origin from earth's deposits, we relieve basalt from a fire origin, while we provide something for the fires to feed one. We see the resurrection of the fuel; the sunshine is exhibited in flame, the rain in vapour, the air in the expelled gases, and the surface matter of yesterday, the illegible dusts of old time, are shown to us in the ashes, the erupted rocks, and the expelled

* See note, p. 189 of the August number.

mud. The earth is an old mother, she never forgets anything. In these wonderful resurrections she shows us the great facts of former existence: the purity of the silex is exhibited to us, it is sent up again to be reconverted into dust, into gelatinous matter, to be again the covering of a grass stem, or to mix in all organisms on the face of this earth; once more to mix with all impurities, and to be buried again—every time with an increasing cause of heat, for this is a heating globe and not a cooling one!

Was the old man of the Syadra Mountains right, were his concentrated thoughts of planetary influence, and elementary action as producing cosmical effects properly expressed? Had he in his solitude read nature's laws from nature's page? If he was right, if we have sufficiently explained his meaning in the mutual relations of the elements to basalt, it must be recognized as a great sign-post on ocean's vast highway.

The rock is before us to answer for itself, its impurities are still as soluble in water as they were when it was deposited by water; these impurities are still as convertible into other materials as they always must have been under the influence of fire, while its pure silex is still there ready to be separated from the impure by the heat of an artificial or a natural furnace.* As the tree is known by its fruit, so we know the basalt by its results. If fire separates its constituents, it did not originate from fire. If some of its constituents are soluble in water, it is made by water sediments; these sediments were formed of the surface matter of yesterday, the dusts, perhaps the ashes, of what had grown on the earth, watered by the rain, nourished by the air, and warmed by the sunbeam; not a primeval rock, but a daughter of time.

In raising our sign-post, we have used with some familiarity those whom we have met on the same road; we have intended no more disrespect to them than we do to Raphael, while gazing with admiration on his Holy Family, and dreaming, in love, of the pure original. We believe the goal of our fellow-travellers is truth; there can be but one road to it. We desire no controversy on minute points. If any one can prove the existence of an internal fire down below the deposits of earth and water, we will accept the admirable dogma of Professor Tyndall, allow that our origin of basalt and our chemical heat are only mental pictures, and endeavour to philosophise over the unknown fuel of the interior of this earth. Till such proof is brought forward, we claim Werner as our guide, and Sir Humphrey Davy, with a few others, as our porters in search of the buried sunbeams in the gneissic schists of our mountain tops, and of our lowest deposits, testified to us in the light given out by the mineral oil from the lamp on the table before us, and exhibited to us all round the world in all deposits, as well as in the basaltic rock.

H. P. MALET.

* See note, p. 189 of the August number.

ERRATUM.

In our last number, p. 191, 2nd column, line 33, for *Pluto and Vulcan* read *Neptune and Pluto*.

DR. BECCARI'S TRAVELS IN MALESIA.

IN the last account I gave of this most enterprising traveller (*Geographical Magazine*, April, p. 20), I stated that he was on the point of leaving Makassar for Kandari, an unexplored region of South-East Celebes. He was, however, against his wish, delayed a considerable time at Makassar, owing to the difficulty of getting a *prahu* to convey him to Kandari, and of finding a suitable set of servants to accompany him there. We shall see by and by what a precious lot of scoundrels he fell in with and engaged. He was not idle, however; and although the letters he wrote in the interval do not contain any scientific novelty, he enclosed in them a splendid set of *camera lucida* drawings of Papuan heads. One especially is of great interest, indicating a very negro-like cast of countenance. He sent, moreover, the description and drawing of a most singular plant, a new species of *Myrmecodia*, which, as the rest of its curious kind, owes in a certain way its existence to ants. It was published lately as *M. selebica* in the sixth volume of the *Nuovo Giornale Botanico Italiano*, founded, as our readers are perhaps aware, by Beccari himself on his return from Borneo. Several months had elapsed and as no further news had reached us of our friend, we were growing anxious, when last mail brought in a long and most interesting letter, written at different dates, from Kandari, and addressed to Marquis Doria. I subjoin a full translation thereof, only omitting a few unimportant passages.

"KANDARI, *April 23rd*, 1874.

"I have received the 9th number (new series) of *Ocean Highways*, in which I find Giglioli's translation of the letter I wrote from the Aru and Key Islands. I must rectify a statement made therein, viz., that leguminose plants are wanting in the Aru Islands. It is true they are scarce, yet some are found there; bee-like insects are also found, but are also scarce, and true bees are entirely absent. Amongst the Aru Island leguminose plants is a species of *Erythrina*, which is fecundated through the agency of birds, and especially by small brush-tongued parrots, some of which have their plumage partly coloured of the same beautiful scarlet as the flowers of that plant. In the same number of *Ocean Highways* I have read a correspondence from Dr. Meyer on the voyage which he made to New Guinea. From what he says he appears to have been very fortunate in his discoveries and collections. The plan which he followed of going from the 'known to the unknown' was most certainly the best. Rosenberg, who also visited the islands of Geelvink Bay, stayed at Ansus, which is annually visited by *prahus* from Ternate, by the bird hunters of Duivenbode, and sometimes by those of the Bughis. Near the isthmus which divides Geelvink Bay from M'Clure's Inlet there is a (Dutch or German) missionary station. Dr. Meyer reckons the height of the Arfak Mountains at 7000 feet; but it is probable that Dumont D'Urville's calculation, 9500 feet, is nearer the truth. The road taken by the German traveller in the ascent of those mountains appears to be the same as that followed by D'Albertis, for he writes that at Dorei he found out that it was possible to make that ascent, not from Dorei, but from a small river more to the south. This river could be no other than that of Andai, where we stayed several months. Dr. Meyer also mentions cannibals in Jobie Island and elsewhere in New Guinea, and describes the inhabitants of Ansus as ferocious. My own informations would lead me to different conclusions; but Dr. Meyer has naturally had the chance of being better informed than I have, having stopped some time at those places. It appears to me to be a very general fact that travellers incline to depict natives worse than they really are; and this probably on account of

misinterpretations to which ignorance of the language and habits of savages easily leads; and perhaps because some people fancy by so doing to give a richer colour to their own adventures.

"With much interest in the same number of *Ocean Highways*, I read the article 'A Cruise amongst the Cannibals.' We met good Captain Redlick, of the schooner 'Franz' at Sorong. He gave me some interesting ethnological objects from the Admiralty and Echiguder Islands. The massacre of part of his crew, which took place while we were at Sorong, without our knowing it, is not, I believe, to be entirely placed to the charge of the Papuans, but mainly to that of the Rajah of Salawatti, who is a great scoundrel. Captain Redlick says that the Sorong Papuans are cannibals; but that is certainly a mistake. He could not speak a single word of Malay, and on his vessel only one man could talk it and a little English."

"*2nd May.*

"I continue my letter, and shall begin by departure from Makassar. On the evening of February the 6th I went on board the *prahu* I had engaged—an old boat, which answered admirably to the description given by Wallace of the one which conveyed him to the Aru Islands: its burden was about 70 tons. Next morning we heaved anchor. Towards evening, on the 8th, we passed through Selayer Strait. In the Dutch charts which I possess ('Oost-Kust Celebes,' door A. C. J. Edeling, Batavia, 1865, with MSS. corrections up to June 26th, 1873; and 'Straat Mangkassar' Blad ii., 1871), the strait of Selayer in the southern passage, which is the most frequented, is not more than 3 geographical miles in length; while in the English Admiralty Charts (No. 942A) it is nearly twice that length. From what I saw, the latter is by far the most exact. The Dutch have a high opinion of their charts, and disparage the English ones; but in point of fact in so doing they disparage in many cases their own doing, for the English charts of these regions are mostly based on Dutch surveys, but always contain more recent corrections. I have seen large and detailed Dutch charts of the strait and roads of Makassar. One of the greatest drawbacks in such productions are the numerous errors in the nomenclature of places, mistakes which cannot be excused in those who are masters of the land; and it is a matter of surprise that the nomenclature is usually far more correct in the English than in the Dutch charts; naturally, taking into consideration the different orthography of the two languages. And I should here observe that it would be most desirable that in giving native names, the Dutch should follow the example of the British Hydrographic Office and of Kaper in his 'Maritime Positions,' viz., to adopt the Italian sound of vowels, which are admirably adapted for the transcription of the languages and dialects of the Malay Archipelago.

"I fain would make a further observation, which appears to me of great importance, viz., that in naming any geographical point not previously laid down, search should be made for the native name, and that given: for if these parts are little known to European navigators, this is not the case with the native sailors, who may often be most usefully employed as pilots, in which case the necessity is obvious of being able to name rightly the different places. I myself have often experienced the very great advantage of having written the native names on my charts. I never had the least difficulty of getting native boats to conduct me to any of such places. Cora's (or rather Di Lenna's) map of Galewo (Papua) Strait is an excellent instance in case. In the charts we possess of that part of the Papuan coast to the north of Salawatti, is an island named Jackson; its true name is Pulo Snapan. When Major Di Lenna surveyed those parts he laid down correctly that island, but under the impression that Jackson Island was another, he marked it also on his map. Now Pulo Snapan and Jackson Island are one and the same thing, therefore the latter should be eliminated from Cora's map (Cfr. *Ocean Highways*, No. IX., 1873). I found, as I said, the spelling of the names on the charts of Southern Celebes very incorrect. During my voyage to Kandari, sailing with natives, I have been able to correct the names of the places we passed, and of others further off, but well known to my travelling companions. Thus, the island in the middle of Selayer Strait, marked Sarontang on the charts, is called by the Bughis Sinkam-loe; Tana (or Tanah) Doan is used to designate a small island to the north of Selayer; it is, however, the true name of the latter, and is on certain occasions used in preference to that of Selayer; for instance, if a *prahu* is making for harbour, the Bughis have a belief that if the word Selayer is used instead of the more proper Tana Doan, the wind will blow off shore, and prevent anchoring. Recently a small additional chart of the Tiger Islands, to the south-east of Selayer, which are laid down dubiously on the English charts, has been published.

"Having passed Selayer Strait, we steered for the north of Kobiana Island (not Kamboena, neither Kambyna). The small island which is to the north of Kobiana is very near Cape Lora, which ought probably to be placed more to the west on the charts. We anchored there, taking in wood and water. We thence wended our way very slowly in the channel between Muna (not Oena) Island and the mainland; we then passed between Great Tobea and Tikola, which is not an island but a promontory; therefore there is no passage to the north of Tikola as would appear from the charts. The best channel is the one we followed, in which the water is never less than 10 fathoms, and no trace of shoals or sunken rocks, as is also erroneously asserted. The bottom is everywhere mud, and excellent holding ground. To the west of Tikola you will find on the charts Kolono Baai—a pleonasm, for Kolono in Bughis means bay. The island of Muna, which is marked as mountainous, is instead perfectly level, except a few very low hills. It is nearly entirely covered with coffee plantations: that shrub thrives well also on a plain, provided trees be kept to shade it. The coffee which is called Buton comes all from Muna. There is a pass between Little Tobea and Muna called the Tioro Strait. On the 22nd of February we entered the outer bay of Kangari. An island nearly shuts off the entrance into the inner bay, which is not at first visible; only the northern passage is practicable for large *prahus*, and even ships of greater draught would find a sufficiency of water. Dutch gun-boats visit nearly every year the inner waters of Kandari, where we arrived on the 23rd. The journey from Makassar had therefore lasted seventeen days, most of which I was laid up with a severe attack of fever, which had been incubating at Makassar, where the diet of the hotel did not quite agree with my spleen, which is becoming sensible to the protracted stay within the tropics.

"*8th May.*

"A chance occasion for sending off this letter has presented itself before I expected. I am therefore obliged to be brief. At Kandari I have rented a small hut on the top of a hill, in the midst of cocoa-nut palms, mangos, and anonas. I include a sketch of it. During the first days of my stay on shore I was unwell; the country promised little, and I have met with many difficulties. I was apparently surrounded by dangers on every side—in the air, fever; in the forest, head-hunters; at sea, pirates; in the village, hostile Bughis; and in my house, my own servants. Never before did I find myself amongst such a set of rogues. Fortunately, this occasion enables me to get rid of a couple of the worst, whom I have sent back to Makassar; and a great weight is thus taken off my mind. They had proved most troublesome. More than one *kris* was sharpened in my honour, and I accidentally discovered the plan they had laid out to revolt as soon as we put to sea. They pretended higher wages. But I determined not to be intimidated, and all they gained was greater

severity, and an extra cleaning of my revolver. They were, besides, continually quarrelling amongst themselves. One fellow attempted to commit suicide, stabbing himself in the breast with his *kris*; and he well nigh succeeded, for I had the greatest difficulty in stopping the hæmorrhage. Another, half-drunk, attacked one of his comrades with a hatchet, and, had I not interfered, threatening to shoot him, and getting him out of the house, the other man would have been murdered. They are, moreover, thieves. Fancy in what nice hands I have fallen at Makassar. The Bughis of Kandari, like all the rest of them, only respect the Dutch through fear. If, therefore, my not being a Dutchman is one advantage, I profit through the wholesome dread they have of the Hollanders. But this is far from being the case with the Alfuros (wild men of the interior), who do not care a straw for the Dutch government, and hunt for heads with the greatest freedom and impunity. In the village hard by, during this month, they succeeded in getting two heads, and my cook ran a narrow chance of losing his in the same way. He had gone down to the spring to wash some rice, when five savages, armed with spears and *parangs*, jumped up and tried to intercept him. But he was quick, and managed to escape. As to my own personal safety in this place it is at present pretty good, and the halo of dangers which appeared to surround me on my arrival partly gone. My health is now good, which I owe in a great measure to the excellent water I get here, and the cold *shower baths* I can take in the forest, morning and evening, thus counteracting the effects of the sun.

"I have purchased a good boat of about ten tons burden, and I have formed a good crew, partly by redeeming *debt-slaves*. My intercourse with the Bughis chiefs of the village are excellent, and the fairest maidens of Kandari have been helping me to sew the sails of my boat. I have also earned the friendship of the rajah of the wild Alfuros or Tokkia as they are called here, with presents and by placing perfect confidence in them, allowing them to go freely in and out of my house. I have made an excursion a few miles inland to a place called Lepo-lepo, where I was able to study the habits and customs of the Tokkia. I cannot now enter into details on that subject, as I should be obliged to say too little from want of time. I shall only mention the general conclusions to which I have come, and which I believe may interest those who study mankind.

"The stay I made, in 1867, amongst the Kajans in the interior of Borneo, has given me the means of being able to recognise at once the nearly complete identity which there is between those savages and the wild natives of this part of Celebes. Had I not been detained writing this letter I should have gone to-morrow on a trip out of Kandari in my new boat. I must now wait in order to replace the two men I have dismissed; for I must not reduce my small crew on account of the pirates, who yet revel on these coasts in perfect freedom. I have just learnt that further north, at Tebunku (marked Sakita on the charts) cholera has broken out. I shall not sail therefore in that direction as I had intended.

"I ought now to say something about collections, but I am sorry to state that on that score I have not much to add, for various reasons. I have not yet been able to see a virgin forest in Celebes; around Kandari the trees have been cut recently, and the variety of plants to be met with in the new forest is small. This is mostly formed by a *Quercus* (oak) and a species of *Castanea*, besides a few *Ternstræmiaceæ*, *Myrtaceæ*, &c. Large tracts are covered by the *Alang-alang* a species of grass, which grows very high. In some of the places recently denuded I have found Moluccan plants, and along the rivers Bornean species. As yet the flora of this country has not offered me any peculiarity. Amongst the native mammals, I have obtained a very remarkable species of wild boar, of which I send a sketch; a species of *Cuscus*, the *Cynopithecusnigrescens*, a *Viverra*, and a stag, which I believe to be *Cervus Kuhlii*. The Anoan antelope (*Anoa depressicornis*) is pretty common; but I have not yet been able to get a single specimen. Wallace is mistaken in asserting that the Anoan inhabits exclusively the mountains, and that it is not found together or in the same locality as deer. Here these last are very abundant, and the Anoan frequent the mangrove swamps, and often go down to the sea-shore like the stags to drink the briny water.

"Little indeed have I done as yet here for ornithology; but the birds are only just beginning to complete their moulting. A few Reptilia and some small and plainly coloured Coleoptera have been collected. Verily, from a naturalist's point of view, I have as yet met with little of interest in this country; but it has proved a most attractive place for an ethnologist. Having a seaworthy boat of my own, I feel very independent, and my future plans are very unsettled, for I can start for Makassar whenever I choose. In June a steamer from Makassar is expected here; I shall then perhaps be able to give you further news of my doings. I enclose in this letter a portrait of a young Tokkia. The head-hunters are after all not so bad looking as one would suppose; and the Tokkia maidens are still less capable of causing fright.

"The *prahu* which takes this letter has stopped on purpose to convey it to Makassar; thus I must conclude, with hearty greeting for all my friends, which I beg you will transmit."

I have scarcely time to add any comment to Beccari's letter, but I may mention that his future prospects are brighter than he is aware of. Hearing of his great anxiety to return to New Guinea in the coming winter, and that he was deterred through want of adequate means (the heavy expenses of his present and past journeys have up to the present been entirely defrayed by his private means) from doing so, the municipality of Genoa, represented by their enlightened Mayor, Baron Podesti, has come forward and placed at Beccari's disposal a sum sufficient to allow him to make a second and more prolonged visit to the land of the Papuas. By the time he next writes he will have received that bit of good news, and will probably leave Kandari to be able to start from Ternate in October or November. I am happy to add that Beccari's merits have been recognized by our Geographical Society, and one of the gold medals has been conferred on him, the other having been given to a second worthy friend of mine and famous traveller, Dr. George Schweinfurth.

HENRY HILLYER GIGLIOLI.

FLORENCE, *August 15th*, 1874.

A CONTRIBUTION TO CYCLONE HISTORY.

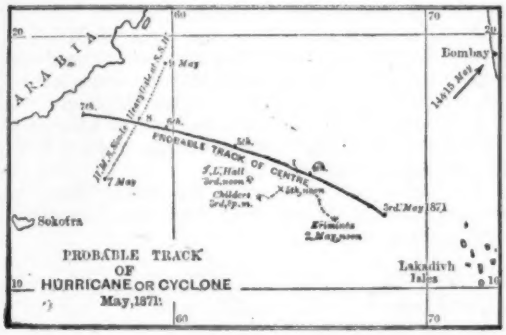
IN May 1871 a great cyclone swept across the Arabian Sea, of which we have some observations; and as all information on the subject of these phenomena is valuable, the present paper hardly needs farther preface, especially as it affords, in the case of one at least of the ships, an emphatic warning to seamen not to neglect the study of the law of storms, and also to act up to what they have learned.

At Karáchi, situated at the head of the Arabian Sea, and beyond the direct influence of these storms, it was obvious, on the 4th of May, that a great disturbance was taking place far away to the south, the indications being a high surf from south, and a very unsettled appearance of the weather. On the 6th and 7th a

strong breeze from S.W. was experienced, attended by a rise in the mean level of the sea, causing very high tides, which did some damage on the 7th and 8th. The full moon was in perigee on the 5th. This was doubtless the wind from the S.E. quadrant of the storm, after the centre had passed to westward, far away south of the place.

It appears to have crossed the sea from near the north end of the Lakadivh Islands, in a W.N.W. direction, towards the Arabian coast, as shown in the diagram. Its violence was probably greatest in about longitude 65° E. The accounts given by the masters of three ships bound to Bombay which experienced it, were published in the *Bombay Gazette* of 15th and 17th of May, and appear instructive.

It is chiefly to them that attention will be drawn, but one sad casualty deserves prior notice. The steamship 'Collingwood,' from England to Bombay, left Suez on the 25th of April, and has never since been heard of. She did not call at Aden, and, allowing a speed of 9 or 10 knots, must have encountered the cyclone about the 5th or 6th, and probably ran right towards the advancing centre, where she foundered. There is no bad weather in the Red Sea at that season, and, had she run aground, something must have been heard of the wreck.



A steamer bound from Aden to Bombay, during the months in which these storms may be expected, observing indications of the approach of one, viz., gloomy, threatening appearance to S.E., with falling barometer, and blowing hard from eastward; knowing also that the track of all these cyclones is between N. by W. and W.N.W., would do well to consider whether she should not run to S.S.W. until the wind veers to N., and then pass round behind the storm, thus making a fair wind of it, instead of struggling on against the wind, and probably right into, or close to, the dangerous vortex. The cyclone months are April, May, June, October, November, and first part of December, but often years elapse without one occurring. In these latitudes, too, masters of ships straight from England must remember that one-tenth of an inch is a serious fall in the barometer.

The first of the three ships referred to is the 'Childers' of Liverpool, which, at 8 P.M. on the 3rd,* was in longitude 63° 20', latitude 13° 35'; wind W.N.W., observed threatening appearance with vivid lightning in the S.E. quarter; barometer, 29.70; sea high from southward. She reduced sail prudently to lower topsails, and at 10 the wind had fallen light. At 11 a gale set in at E.; at midnight a deluge of rain fell, and, the gale increasing, his fore and mizen topsails blew away. *He then put the ship on the starboard tack.* Barometer 29.2. At 4 A.M. on the 4th the wind blew a complete hurricane at N.E., and from that time up to noon it was terrific, gradually drawing round to N.W. Several of the sails blew off the yards out of the gaskets, although extra lashings had been passed round them. By noon the wind was at N.W. by W. Barometer 29.2. The rain was very heavy, and also the sea, the tops of which blew over the ship in a continual spray.

At 4 P.M. the sky appeared to break a little; wind in heavy gusts from W. and W.S.W. At midnight barometer 29.35, wind at S.W., and moderating. At 4 A.M. on the 5th she ran to N.E. on her course, and at noon passed a quantity of spars in latitude 14°, longitude 64° 20'.

The master of this vessel reasoned quite correctly that the storm would pass to the northward of him; but why did he not heave to on the port tack, so as to "come up" to the wind, and head away from the centre? Doubtless his best course would have been to run to S.S.W., when he would probably have escaped the bad weather, and saved his sails, &c. It is true there is a natural disinclination to put the ship's head away from her port, but in this case, with such a low barometer, there could be no doubt about its being a cyclone, and to avoid such storms ought to be considered a positive duty, whenever practicable, and not a matter in which there is any option.

The second ship is the 'J. L. Hall' of Liverpool. She noticed at 4 A.M. on the morning of the 3rd that the barometer had fallen one-tenth, and was then at 29.53, with freshening wind at N.N.E., high, confused sea, and much lightning, and, in consequence, prepared for bad weather. Ship's position at noon—latitude 14° 13', longitude 63°. At 8 P.M. the barometer had fallen to 29.35; gale steady at N.N.E. *Wore ship to north-westward on starboard tack.*

The morning of the 4th began with an increasing gale, and wind veering to the northward, and at 4 A.M., considering that a cyclone was passing to northward of him, he wore to the eastward; barometer, 29.20; wind at north.

At 10 A.M. it blew a hurricane, barometer 28.95, with very heavy sea running, wind veering to westward; at 2.30 P.M. barometer was at its minimum, 28.83, and wind at W. by N. From this time, when the centre was passing the ship, the gusts are reported as terrific. The lower maintopsail, the only sail set, was blown away out of the boltropes, although probably the strongest sail on board. The ship at this time was lying with her gunwale in the water, and her cargo of coals shifted. At 6 P.M. the barometer began to rise, and at midnight stood at 28.90, when weather had moderated, and sea was falling quickly. At 4 A.M. on the 5th stood to N.E., with a S.W. wind. This ship lost part of her bulwarks, boats stove in, &c. This ship, as is evident from the barometer, was closer to the centre. She made a mistake at first in heaving to on the wrong tack, but redeemed it when she found which way the storm was going, and afterwards lay to on the right tack. A

* Month throughout, May. Longitude E. of Greenwich. Latitude N.

similar remark to that on the 'Childers,' about running to S.W., is here also applicable. It is the third vessel, the 'Eriminta,' whose account is interesting, as an example of what a ship ought not to do in a cyclone. It will be seen she had a narrow escape of foundering: she scudded nearly twice right round the cyclone, and escaped only by the fortunate chance of "broaching to" behind the storm, and remaining so, notwithstanding the efforts made to resume her race with destruction. Her account states or assumes that she got into more than one cyclone! and is, much abbreviated, as follows. It is the more remarkable, as it shows considerable knowledge of the theory on the part of the master.

At noon on the 2nd she was in lat. 12° 48', long. 66° 10', with threatening weather, and at 8 the next morning the ship was prepared for bad weather. The account says, "*I concluded there was a cyclone to the eastward of us, advancing to the N.W., and decided to steer to the S.W. to avoid its violence.*" This was quite correct, and one can only express surprise and regret the excellent intention was not adhered to. At noon on the 3rd the barometer had fallen to 29.50, wind N.N.E., and increasing and constant heavy rain. Careful preparations for bad weather were in progress. At 2 P.M., the ship was kept S.S.W., and had this been adhered to, all would have been well, but at midnight the wind had veered to N.N.W., barometer 28.90, and the ship was kept scudding *before the hurricane*, under bare poles, and going at a frightful rate, the following being the state of things:—Sea mountains, decks and cabins flooded with water, all hands on deck, at the wheel, relieving tackles, some at the pumps, when possible, and baling out water; at 10 P.M. the lower foretopsail and foretopmast staysail blew away, knocked some of the planks off the bulwarks to let the water run off.

At noon on the 4th they had made a *complete circuit in the twenty-four hours past, always keeping before the wind and seas.* The veering of the wind was by N.W., S., and E. round to N. again; they were then steering S.S.W. again, the barometer, 28.60, showing an approach to the centre. It is described as "a fearful gale, many of the sails beginning to blow away from the yards out of the gaskets; impossible to do anything to save them. All the running rigging about the decks washed overboard and to pieces, and the upper portions of it streaming away in the wind. The spray flying over us and the constant rain hiding the forward part of the ship from view on the poop; ship going from 12 to 14 knots and behaving well, *although I was in constant dread of broaching to.*"

By midnight the hurricane was really terrific, the wind had now veered to W.N.W. in its second circuit, barometer at 28.10. At 4.30 A.M. on the 5th the barometer stood at 27.90, the wind raging with all its former violence from W., the approach to the centre being fearfully indicated by the barometer. At 5.30 A.M. the ship broached to, and after an ineffectual attempt to resume the dangerous scudding, "*I decided to to let her lie.*" The danger was fortunately over, for the centre must have borne to westward of north, and was travelling rapidly to W.N.W. At noon the hurricane began to abate, the wind having veered to S.E. (? S.W.) barometer 28.50, rising fast. After broaching to, the ship was left a wreck, the mizenmast having been cut away when she broached to, in the attempt to get her before the wind, carrying with it the main top-gallant mast and yards. The bulwarks and railing stove in, also front of poop and forward house. "The lee side all under water, and our uncertainty whether the ship was filling with water, together with the roaring and screaming of the wind, the mountainous sea, and driving spray, created a scene that can scarcely be realized by any who have not experienced the same."

At 4 P.M. on the 5th they got to work at the pumps, and got the ship clear by 11 P.M.; they then proceeded to clear away wreck, and at noon on the 6th got the lower maintopsail set, which was the only sail left of our best suit that was fit to set." Latitude at noon 14.53, longitude 62.25, drift in three days 153 miles N.W. Barometer 29.30.

Another ship, the 'Louisa,' which left the Mauritius for Bombay on the 10th of April, probably foundered in this hurricane.

Other observations have not been traced, except the following: From the 7th to the 9th, the steamer 'Sind' had a tremendous gale at S.S.W. and scudded before it as shown on the diagram, this was probably a blow out of the back of the storm after it had passed to the westward.

The steamer 'Apis' left Bombay on the 2nd, met with a cyclone on the 6th, was in it two days, during which time her fires were put out; she arrived at Aden on the 15th, but no particulars are given.

A storm is reported down the coast of Malabar, about 4th or 7th, with southerly gale and strong northerly current; it is therefore probable that the storm had its origin near the north end of the Lakadivh group.

In Bombay bad weather seems not to have been experienced until the 14th and 15th, when a S.W. gale with rain occurred.

The relative approach of the three ships to the vortex may be estimated from the barometric depression.

'Childers'	29.2
'J. L. Hall'	28.83
'Eriminta'	27.90

The narrative of the latter vessel gives no reason for departing from her original intention to run to S.S.W.

THE TRAVELS OF JEROME CARDAN IN SCOTLAND.

THIS crack-brained genius is, or used to be, known, by name at least, to a multitude of schoolboys, from that name having been bestowed on a mode of solving cubic equations, which was none of his. Most of those boys probably have had no occasion to make further acquaintance with him; some, however, certainly must have been glad to do so through Mr. Henry Morley's life of him, a work which I have not seen for many years, and which was not indeed on a level with that other delightful history of his more estimable hero Bernard Palissy, but which was read with enjoyment in those pleasant days before the Indian cataclysm of 1857, when John Company yet reigned and brave Dalhousie governed. Of late years I have had occasion once or twice to turn to the dusty shelf of a public library which groans under the ten volumes of Cardan's works, and I have extracted from his

treatise *De Rerum Varietate* (which might be rendered, "concerning things in general") such passages as touch on his visit to Scotland, a country then so little known to Italians, and not very much known to them now. Cardan's fame, however, had travelled to Scotland, and especially it would seem that of his medical skill. Hamilton, Archbishop of St. Andrew's —*Amultho* as Cardan Latinizes him—desired his advice for an asthmatic complaint of many years standing, and inveigled him to Lyons on the pretext of meeting him there; thence to Paris; and thence, after much reluctance, to Scotland, where he passed some months in the year 1552. It is not always easy to tell when he is speaking from information gathered by himself, and when copying from the Scottish History of Hector Boece, whom he sometimes quotes by name. No library within my reach will furnish Boece's History, and I must take my chance of stumbling on such second-hand matter.*

Though he was there in the summer he found Scotland a bare and gusty land, "*tota ferme sterilior*," abounding in lakes and mountains; and the wind used to blow so fiercely, that at a certain place that was not ten paces wide, it was impossible to pass except by running across, a feat to which stout young fellows used to challenge one another as a contest of strength.

Some good things were produced in this bleak land however; and one of these was salmon. "The true glory of fresh waters," he says, "may be said to consist in two *genera* of fish, the trout and the sturgeon. Each of these embraces many species, but the most illustrious is the salmon, which we have often eaten in Scotland." Another delicacy consisted in certain game-birds, but his account of them is not without perplexities.

"In Scotland they have the *Avercalzie*, which is found nowhere else. The name means in their tongue 'Horse of the Woods,' for the call is like a horse's neigh. The bird is somewhat bigger than a crow (!), and feeds only on the buds and tender leaves of the pine; there are also cocks of the woods, which feed on the leaves of broom (? *cytisi*); both kinds are excellent eating, for we have often partaken of them. And they feed on the heather yet more than the broom." His under-estimate of the size is extraordinary if he had really eaten the capercailzie; perhaps *corvi* is a mistake for some other word, but no probable one occurs to me. He appears to be quite right about the *name*, for I find in the English Cyclopædia the following quotation from Pennant: "This species is found in no other part of Great Britain than the Highlands of Scotland north of Inverness. It is there known by the name of capercalze, *Auercalze*, and in the old law-books caperkally—the last signifying the *Horse of the Woods*." Cardan's other bird—*Gallina silvestris*—it was impossible to render literally according to gender, for he evidently means a black-cock. He has also a paragraph about a rare shy game-bird, sometimes found on the banks of the Tweed, with plumage and meat not unlike those of the partridge, but bigger than a swan; the natives called it *Gustard*. I know not if this is a genuine form of bustard or a mere error; the passage is probably from Boece.

Another *friandise* which he tried in the north was apparently not so acceptable as salmon and capercailzie. After rehearsing the story of the clack-goose, or bernicle, from Boece, he goes on:—"There is another kind of goose found on a rock near the Isle of May; it is called *soland:* perhaps Pliny's Sea Eagle. They come in spring, and bring such a quantity of sticks as to supply sufficient fuel to the garrison. Men turn them to this account, and also take from them the fishes that they catch—and these are the biggest and best!—whilst the birds go and fetch others and show no resentment. But this is a small matter! for they patiently endure their young, as well as their nests, to be taken from them, and make no disturbance, neither does this drive them away. They have quantities of fat under the skin; this is used for dressing wool (viz., for spinning? *hac lanas inficiunt*). In a certain small gut, also, they have another kind of fat, which is excellent for pains in the hip-joint. The bird itself is very like a goose, but when I was eating it I was sensible that it smelt strongly of fish. The bird is certainly a wonderful example of patience, and, so far as the Scots know, it is found nowhere else; but it must, of course, pass the winter somewhere or other. The profit it gives is manifold — viz., from sticks, feathers, fat, and young ones—and it is said to amount to 500 golden crowns yearly."

Scotch ale met with his approval—*hala* he calls it. It seems to have had the luscious character of the Scotch ale of our own youth, now, I suppose, extinguished, and deservedly so, by the wholesomer popularity of bitter beer:—"The *ale* which is made in England and Scotland is much pleasanter drink than beer (*zethum*); insomuch that I remember, when I first entered Scotland, drinking some that reminded me of sweet white-must; in fact, there was no difference, except that the ale left a more bitter and less pleasant aftersmack." After describing the manufacture, he adds—"It differs from beer *in the omission of the hops*."

He has not much to say of vegetable products. We sometimes in Scotland talk big about the ancient forests that once were, but are now swept away. Cardan's view, however, is, it must be confessed, very Doctor-Johnsonian. After speaking of the Orkneys, and their treelessness, he says—"Should it be asked, as it well may be, why there are no trees in Pomonia, I must reply that it is no wonder, since this happens even in Scotland, and in many places thereof trees are cherished with much nursing, as we should cherish an orange tree (*Arbor Medici mali*) or some other exotic." But this nursing was sometimes diligent and successful. After quoting passages from ancient authors on the beauty of the *platanus*, he proceeds—"Now it is a surprising thing that this tree, which is so neglected in modern Italy as to be hardly ever seen, is, through care and diligence, very common in England and Scotland. I counted in the shrubbery of the monks of St. Augustine, in the vicinity of Edinburgh, more than twenty plane-trees, some of them more than 30 feet high, and yet the climate is a very cold one. The thing is due in part to diligent care, but in part also, I fancy, to the vicinity of the sea, which tempers the severity of winter. I think they take a special delight in that tree, because its foliage is so like vine-leaves; indeed, when I first saw the young shoots that had been planted, I thought those Scots were actually

* See for the following passages *De Rerum Varietate* capp. 1, 4, 6, 16, 23, 24, 33, 34, 36, 37, 97.

growing vines! 'Tis like lovers, who delight in portraits, when they can't have the original."

A question suggests itself—Whether these trees at the Edinburgh monastery were the real *plane (Platanus orientalis)*, or only the species of maple commonly, but erroneously, so-called in Scotland *(Acer pseudo-platanus)*, and still more erroneously called in England "sycamore."* From Cardan's speaking of planes as so common in both countries, we may well suspect that they were really the maple in question, the more so as the Scotch monks, no doubt, would call them planes. Pliny says that the plane in his time had penetrated even to the land of the *Morini*, a people on the Calais coast, or as Ph. Holland gives the passage in his manner—"The very plane, brought first over into the Island Diomedea . . . . from thence translated into Sicilie . . . . but now it is caried as far as Terwin and Tournay in France . . . . insomuch as people that will but walke and refresh themselves under the shaddow of it must pay a custome therefore unto the people of Rome." A late German writer expresses a doubt about this, like that which we have just expressed as to the Platanus in Scotland, and suggests that it was the *Acer-Platanoïdes* (or Norway Maple of our gardeners), though possibly he intends the same tree that has just been mentioned *(A. Pseudo-platanus)*.†

An observation that Cardan makes incidentally regarding thistles in Scotland is somewhat remarkable, and if it were true would reduce the national motto and emblem to a very empty brag. Nearly all of them, he observes, were without prickles!

Sheep with four horns, he says, were frequent; not like those that he had seen at Milan, for the Scotch ones had one pair curved and the other pair straight. The phenomenon is certainly not a common one now in Scotland.

In a passage on the Hebrides, Orkney, and Shetland Islands, he speaks of the Shetland ponies, "*equi exiles et asinis quasi similes tam patientiâ quam magnitudine.*" The furthest of the Hebrides towards the north, he says, was *Istlandia* (a name on which my friend Mr. Major would have much to dissert); but, he adds, it was scarcely to be counted among the Hebrides, being so big. In that island bread was made from meal of dried fish (like among the Arabian Ichthyophagi of Strabo and Marco Polo). This is perhaps out of Boece.

The nature of both soil and stones in Britain is, he says, so bituminous that not only are there stones that burn, but a kind of earth also with heather roots in it. Beyond the city of Newcastle he found this kind of fuel preserved in stacks. It was used not only for kindling fires, but for roofing houses in place of tiles. The very soil of Britain *used* to shake under him as he rode, as when he travelled with Hamilton to *Lisco* (Linlithgow?). The cause of this was not any hollowness under the soil, but because the soil itself was of that black nature like an empty fungus. This soil also is burnt, and both of it and of the stones which are so abundantly consumed in Scotland, the price is much lower than that of firewood in Italy.

There can be no truth, he observes, in the theory that gems are produced by heat of climate; for, cold as Scotland is, it produces lapis lazuli (*cyaneus?* perhaps sapphire), and also diamonds and carbuncles, especially in the neighbourhood of Glasgow, a town in the district of Clydesdale (*Gludisdalia*), adjoining Argyll (*Argadia*), the most westerly province of Scotland, and nearest to Ireland.

"Pearls too, it is plain, may be found in any part of the ocean, for we know how great is their abundance in regions of the south, and here also in Scotland, under the pole, they are found in large numbers. I remember seeing upon the head of a damsel in Edinburgh, the daughter of Thomas Thomson [*Tonson;* it should surely have been Tammas Tamson] a wreath of about 70 Scotch pearls, all of a size, and that size remarkable. They are equal to the Indian pearls in roundness, whiteness, and purity, but the latter surpass them in size and splendour: for the biggest Scotch pearls are scarcely ever larger than the nail of the little finger . . . . . I have also seen these Scotch pearls at Milan, and the price put on them was not contemptible, though not so huge as that put on Indian pearls."

Here we conclude our extracts with one note that Cardan made on his way to Scotland. When at Paris, he went to see the church of St. Denis, and in this he found the horn of a unicorn suspended. It was let down for him to examine, and he found it so long that he could not reach the top of it with his arm stretched to the full; it was very slender and taper, and marked by a series of bands rising spirally from base to point.

This was evidently the tusk of the sea-unicorn or narwhal; and it is a curious fact that this has from time immemorial been confounded with the horn of the genuine monoceros, viz., the rhinoceros, and has mainly assisted in developing the fabulous unicorn. We trace the confusion in Aelian, who says that the horn of the monoceros or *Kartazônon* (the Arab *Karkadân* or rhinoceros) was not straight but screwed (*Hist. Anim.* xvi., 20). The mistake may also be traced in the illustrations to Cosmas Indicopleustes (6th century) from his own drawings. A mediæval drawing, showing the quadruped with an evident narwhal horn, may be seen in my *Marco Polo* (ii., 234). And that accomplished traveller Pietro della Valle, relates how, when a passenger on board the English ship 'Whale,' Captain Nicholas Woodcock, at the mouth of the Persian Gulf, on his way to Surat, in 1623, the skipper showed him a piece of unicorn's horn that he had found on the coast of Greenland; this was like old ivory, hollow and smooth within, and twisted. Captain Woodcock knew it to be unicorn's, both because he had proved its virtues against poison, and because it answered to the description in authors. Della Valle could not agree on the last point, as he remembered that Pliny described the horn of the unicorn or monoceros as *black*. Both were right. The unicorn supporter of the royal arms still carries for a horn the twisted tusk of the narwhal.

H. YULE.

* An error which has begotten another, viz., that several travellers in Persia—among them, if I remember rightly, both Arthur Conolly and Baillie Fraser—constantly call the *Chinár* or Platanus "sycamore."

† *Pliny*, by Philemon Holland, Book xii. ch. 1 (I. 358); *Hehn, Kulturpflanzen und Hausthiere*, &c., 1870, p. 204.

IMPRESSIONS OF JAMAICA.

CHAPTER III.—KINGSTON AND BLUNDLE HALL.

BLUNDLE HALL is a type, or I should rather say the archetype of Jamaican hotels or inns. Strictly speaking, there is neither inn nor hotel on the island, if we take our homely notions as the test of nomenclature; but the "halls" are sort of boarding-houses which fill the void; and Blundle Hall is not only the biggest but the best of those peculiar institutions. It stands, I hope, like Scotland, where it did; and it stood, when first I set foot in its verandahed shade, on the right-hand side of the way going up that long road from the wharf which passes the eastern end of Harbour-street, where the large guinep tree flourishes. There is something very stately, solid, and enduring in the noun-substantive "Hall"; and if a stranger who had just landed at Kingston were to set forth on his unassisted search after some ideal mansion answering to the name, he would most likely pass by Blundle Hall without regarding it. Still the place has a fairly comfortable look of hospitality, which well bespeaks the good entertainment within. In one respect, too, it resembles a hall of the oldest Saxon character, in its having a courtyard. Farther than this, likeness there is none. Blundle Hall is built, as are most of the habitations in Jamaica, on a brick foundation which stands about 7 or 8 feet, perhaps more, above the ground, and which, having a concrete or earthern floor of its own, is usually panelled off into a spacious bath-room and two or three humble offices. The superstructure of dwelling-houses in the British West Indies is in nearly all cases wood, and wood alone. Glass windows are rarities, the jalousie blind being better adapted to the purpose of a tropical casement, which is to keep out the sun and the rain, and to let in the air, with so much tempered daylight as is necessary. Many Jamaican houses have, and Blundle Hall has, what is erroneously called a "piazza"; that is, a covered gallery or alcove between the penetralia of the dwelling and the outer air. In this gallery it is good to lounge in rocking chairs or to recline in grass hammocks, slung from pillar to post, when the burning heat drives us to seek out cool and shady places. Ice, for the unlimited supply of which necessary an extra charge of twopence a day, at the most, is made in your bill, is freely used, as a matter of course; and one of the delights most commonly associated with the piazza is a glass of cold lemonade, skilfully concocted with the juice of green limes, which have been freshly plucked for the purpose from a convenient tree. It is usual for the butler who supplies us with this nectarean draught, to hang across the rim of the goblet a long curling ribbon of peel, whose fragrance alone is a refreshment.

Both back and front, Blundle Hall has its covered galleries, or "piazze," if we may help to perpetuate the mistaken term. The business of eating was chiefly conducted in the verandah-like apartment, approached by a flight of wooden steps from the sandy street. Blundle Hall is the place for a regular old-time planter's breakfast. The planter's own particular dish, as common throughout the year as rashers of bacon in England, is salt-fish and akee, the fish being Newfoundland cod, which is also the cheapest food among the negro labouring class, and the akee being a useful fruit which was brought into Jamaica from the West African Coast in the slave time, and is not very unlike a hard boiled egg in appearance and flavour. Ox-beef, freshly killed, usually makes its appearance in the form of huge steaks, which are of course tough, but somehow not quite *so* tough as might be expected, considering that the animal was alive half-an-hour before breakfast. There is in Jamaica a fruit called the papaw, a few drops of which, squeezed over fresh meat, makes it tender; but the action, which seems to be that of the gastric juice itself, disintegrates the food to such a degree as to render it repulsive to most palates; and therefore I am not surprised that the papaw is rather out of favour with Jamaican cooks. Any expedient for keeping fat dishes from chilling, in that wonderful climate, would be a greater boon to the dainty eater than the means of making hard meats easy of mastication. Our fresh fish, at the Blundle Hall breakfasts, was almost invariably deep-sea snapper, of which it is quite possible to grow tired in time. Only as a treat was the incomparable calipiver, a firm white fish that combines all the virtues of salmon and mackerel with a rare zest peculiarly its own, sometimes served up to us at the morning meal. The abominable turtle-steak never failed to make its appearance. This meat, which in a solid state is deservedly scorned by the poorest negro, is only fit to be expressed in soup; and I need hardly say that no "stock" is so fine as that obtained from the coarse fibrous flesh of the turtle. Oddly enough, the art of making turtle-soup is very little practised or understood in Jamaica. Only at the tables of Sir Henry Storks and General O'Connor did we get such turtle, thick and clear, as would have made the estimable Mr. Painter, of Leadenhall Street, bilious with an artistic envy. But, indeed, Sir Henry had brought with him from Malta, or, rather, had been followed out by, a cook; French, I believe; who was truly a genius. It was this great creature's praiseworthy habit to study the dishes of every country he visited, and to better the instruction, as only a born cook could do. More than one artfully refined luxury of Maroon gustative tradition made its appearance on the Governor's table, during that unsettled time. At Blundle Hall one had no such recondite cookery; but all was very good, and so various as to be on that account charming. We were never without cassava cakes, a delicacy the more enjoyable because of the frequent philosophical reminder that the root from which they are prepared is unwholesome, nay, some go as far as to assert, virulently poisonous. That respectable botanic authority, Dr. Darwin, gave it as his opinion that the maniock or cassava is rendered harmless by the heat it undergoes in being made into bread, and not, as is popularly imagined, by riddance from its superfluous juice. Sir Hans Sloane also declared that the dreaded cassava juice, however acrimonious in its raw state, becomes, when boiled, as innocent as whey. At all events, the thin crisp cakes made from the rounded root, and roasted on a griddle, may be eaten with no less impunity than relish. We had yams, of course, and fried plantains, nor was the sweet potato often wanting for those who preferred it to yam. Of this fine root, there were two kinds within my cognisance, one as yellow as maize-meal, the other as white as wheaten flour. Carefully baked, the yam is a passable

vegetable, more nutritious, I believe, than our British grown potato. There are three delicacies native to Jamaica, but of aristocratic rarity throughout the island, so that we seldom or never saw them at a table d'hôte. I speak of the black crab, the mountain mullet, and the ring-tailed pigeon. It happened that these among animal food, and the mango among fruits, were as much out of season when I was in Jamaica, as anything ever is in that little-varying climate. But I tasted them all. Of mangoes there are many kinds, every one of which was brought to the West Indies from the East; for, indeed, scarcely anything prized in Jamaica is indigenous. The only mango free from a turpentine flavour is the fruit called Number Eleven; and this is a pleasant and refreshing morsel. The other mangoes, to what number beyond eleven I know not, are only good for pickling. The black crab is a land species of crustacea, as small as the smallest river crabs found in England. In cooking, three or more black crabs are wanted to fill one shell with properly picked and prepared meat; and the dozen shells, comprising the edible parts of three or four dozen crabs, are baked and served hot. There is but one approved way, also, of cooking the mountain mullet, which is to wrap that marrowy fish in a plantain leaf, as the red mullet of the Eastern hemisphere is sometimes judiciously cased in paper. There are many ways of dressing the ring-tailed pigeon; but as I have so much of the naturalist in me as to forego the most tempting dishes of which any sort of pigeon is the staple, I can give no report touching this dove of doves in the West Indies. An edible which I had almost forgotten is the mountain cabbage, by which misleading name is called the tender top of a palm, excellent either when dressed artichoke-fashion or pickled. Sometimes we were indulged with a branch of oysters. "To a European," says Mr. Gosse, "it is a strange sight to see a grove of trees growing actually out of the sea, and his admiration is not diminished when he examines more closely the structure of these singular plants. The trunk of every tree springs from the union of a number of slender arches, each forming the quadrant of a circle, whose extremities penetrate into the mud. These are the roots of the tree, which always shoot out in this arched form, often taking a regular curve of 6 feet in length before they dip into the mud. The larger ones send out side shoots, which take the same curved form at right angles; and thus, by the crossing of the roots of neighbouring trees, and of the subordinate roots of each, a complex array of arches is produced, on which one may securely walk for hundreds of yards, probably in some places for miles, about 18 inches above the mud, or above the surface of the water when the tide is in. The average thickness of these natural bows is about an inch, and if stretched straight, they would hardly support the weight of a man; but their vaulted form greatly increases their strength, and though they frequently swerve a little under the foot, I never knew one break." This, to be sure, is a vegetable phenomenon; but much as it may surprise the European visitor to inspect the strange formation of these shrubs, I think he will marvel still more when he sees on a breakfast table a fresh, dark-leaved bough, the woody stem of which is encrusted with oysters, varying in size, but on an average about as large as those of Cancale or Ostend; of the same shape, and same depth of bottom-shell, and, I venture to assert, quite as delicious as any ever placed before the critical diner at the "Trois Frères Provençaux."

GODFREY TURNER.

TEA CULTURE IN JAPAN AS AFFECTED BY OCEAN CURRENTS.

THE cultivation of the tea-plant in Japan extends as far north as 39° N. latitude, which is three degrees further than the average limit. This peculiarity is due to certain meteorological conditions, which Herr A. B. Weber, a member of the German Geographical and Ethnological Society at Yokohama, has been at pains to investigate during a four years' residence in Nügata, a town on the west coast of Japan, just opposite the island of Sado. From his observations it appears that in summer the prevailing winds on the west coast are from the south and south-west, and that during their continuance a strong current sets northwards; but should these southerly winds increase to a gale, *on their subsiding* an equally strong current sets southward, without, however, any accompanying wind from the north. In winter time storms from the south-west are unfrequent, and so it is seldom that there is any exception to the regular set of the northward current.

Now in looking for an explanation of this abnormal feature, Herr Weber found that most of the maps and charts recognized the existence of a warm *and* a cold stream; on the other hand, Findlay's North Pacific Directory and Wyld's Map of Japan make mention of a cold current only. But Herr Weber's meteorological observations put it beyond a doubt that there is practically no difference between the temperature of the northern and southerly currents, and that with the single and remarkable exception above cited (*i.e.*, after the subsidence of a strong southerly gale) both streams are accompanied by winds of the same direction as themselves.

The explanation, like most problems in nature, when really grasped, is very simple. The breadth of the straits of Corea is greater than that of the Gulf of Tartary, La Perouse and Sangar Straits, all put together. Through the straits of Corea flows an arm of the warm Kurosiwo or Black Stream of Japan. When a strong south wind sets in and helps this current on, the mass of water is then too great to escape by the narrow outlets to the north, and it accumulates to such a degree that the difference between the ebb and flood-tide, which on the eastern side of the straits of Sangar is from 2 to 3 feet, is no more than 5 inches inside the Sea of Japan. This flooding continues till a lull in the gale admits of the pent-up waters rushing back whence they came. The southward current is thus but a *reflux* of the northward. The possibility of the existence of a cold current is out of the question, as, from all accounts, there is a constant flow from the Sea of Japan through the Sangar Straits, while again the mean temperature during three years was 10.48° Reaumur, or 55° Fahrenheit, which is above the average of places on that parallel of latitude. This abnormal warmth is, of course, eminently beneficial to the tea-plant, and for upwards of a hundred years the Etsigo plains, in the vicinity, have been famed for its growth.

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THE HIGHEST MOUNTAIN IN CORSICA, as determined by the triangulation recently carried on under Captain Perrier, has proved to be Monte Cinto. Its height is 2707 metres or 8882 feet.

Reviews.

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MR. COOLEY'S PAMPHLET.*

IT is melancholy to find a ripe scholar, far advanced in years like Mr. Cooley, expending his powers upon barren and useless discussions. It is true that he has had much provocation, but he has also given provocation. The time has surely come, for him at least, to forget and forgive.

In the history of geographical progress during the nineteenth century, Mr. Cooley has won and will hold a prominent place. He was one of the original Fellows of the Geographical Society in 1830, and it is now nearly half a century ago since his earliest work, *The History of Maritime and Inland Discoveries*, was first published. In 1846 he planned and originated the Hakluyt Society, of which he was the first Secretary, holding the post until 1849, when he resigned owing to a physical infirmity. He edited a small but interesting volume, *Maynard's Voyage of Sir Francis Drake in* 1595, which was printed in 1849. In the same year Mr. Cooley did good service to Arctic research by the publication of Erman's travels in Siberia, including excursions down the Obi to the Polar Circle. But it is on the papers which have appeared in the pages of the Royal Geographical Society's journal, that his fame as a comparative geographer will mainly rest. In 1833 appeared his memoir on the tribes inhabiting the highlands near Delagoa Bay, with a proposal to send an expedition thither from the Cape of Good Hope. Mr. Cooley, in 1834, drew up instructions at the request of the Council of the Geographical Society, for Mr. W. Bollaert, who had undertaken to cross the continent of Africa, from Zanzibar to the West Coast. Unluckily, sufficient funds could not be raised, and the project was ultimately abandoned. Mr. Cooley's work, entitled *Negroland of the Arabs Examined and Explained*, was published with a map in 1841. It gave an entirely new interpretation of the various accounts found in Arab writers respecting the interior of the African continent, based upon the works of El Bekri and Ibn Batuta. Colonel Jackson, then Secretary of the Geographical Society, in writing of this work, says that its great merit and value spring from the author's critical accuracy in estimating the reliance to be placed upon his authorities as evidence, and from the cautious logical strictness with which he draws his inferences. Nor does the only merit of the work consist in its strict scientific examination of evidence. It also elicits positive results. Mr. Cooley has done what no author has done before him, in placing in a clear and satisfactory point of view the nature and extent of the knowledge which the Arab writers of the middle ages possessed of the countries of Africa south of the Atlas. His next important African work was *The Geography of N'yassi; or, The Great Lake of Southern Africa Investigated*, published in the Geographical Society's Journal for 1845, and followed by *Further Explanations in Reference to the Geography of N'yassi*, in 1846. The same subject was resumed in 1852, in a work entitled *Inner Africa Laid Open*, containing all the information that could then be found respecting the routes across the continent. In this series Mr. Cooley not only collected information from every attainable source, but reasoned from it, and constructed a map displaying very remarkable critical sagacity. It was here that he first brought to the knowledge of English geographers the journeys and discoveries of Lacerda, Gamitto, and the Pombeiros. In his map he places the river Lulua correctly as a tributary of the Congo, which was afterwards misplaced by Livingstone. But he makes the Luapula to flow into lake Tanganyika, and he delineates the Tanganyika and Nyassa Lakes of modern maps as one long sheet of water called "N'yassi, or the sea." Mr. Cooley still adheres to the accuracy of these delineations, and, at least as regards the Luapula, with some weight of argument. The separation of the lakes is a question which appears to have been decided by Dr. Livingstone having passed between them, and by his remains having been conveyed to Unyanyembe by the same route. Considering the date when it was prepared, Mr. Cooley's map of 1845 is a very remarkable production. It contains the district of Uvinza lately traversed by Lieutenant Cameron; the district of Monomoezi (Unyamwezi); the name Oyiyi (Ujiji); and the name Zanganyica (Tanganyika) as a town on the shores of the lake. The most glaring mistake is in making the Zambesi (Chambese) flow into the south end of the lake, instead of forming the upper part of the Luapula. Captain Burton, in his *Central Equatorial Africa*, frequently quotes Mr. Cooley's paper. The great explorer gives the comparative geographer the credit of having "determined the position of the great lake as early as 1845 in a most able paper," and says that Mr. Cooley's estimate of the marches from the coast to the lake was the closest yet made; Sir Roderick Murchison also bestowed high praise on Mr. Cooley's map, in his Address, in 1845.

In 1849 Mr. Cooley communicated to the Geographical Society a valuable paper on the "Regio Cinnamomifera of the Ancients," in which he directed attention to the eastern angle of Africa, and to the country watered by Haines's River. In the Society's journal of 1854 there are two notes by Mr. Cooley, one on the travels of Ladislaus Magyar, and the other on a journey across Africa from Zanzibar to Berguela, by way of Ujiji and lake Tanganyika, the Cazembe's capital, and Katanga, made by a native of Surat named Abdel and some other traders. In 1854 Mr. Cooley published *Ptolemy and the Nile*, in which, as Sir Roderick Murchison said, in his Address of 1859, "The acute scholar shows that the true Nile of the ancients was the Blue Nile, and that, according to Ptolemy, the great lakes were on the Equator." Such have been Mr. Cooley's principal published geographical labours.

In his present pamphlet he attacks the constitution of the Geographical Society, and rakes up feuds and misunderstandings with men now passed away, the memory of which ought also to be buried. Mr. Cooley may have had causes of complaint against bygone officials of the Geographical Society; but he ought rather to remember that his chief works saw the light

*Dr. Livingstone and the Royal Geographical Society. By William Desborough Cooley. (Dulau, 1874.)

in the Society's Journals, and that successive Presidents and Secretaries, Murchison, Hamilton, Greenough, and Jackson cordially and generously ackowledged the value of his geographical services. Mr. Cooley's feuds with African travellers commenced, we believe, with his pamphlet attacking Captain Burton, entitled *Memoir of the Lake Regions of East Africa Reviewed*, which was published in 1864. Their latest development, before the present publication, was the somewhat sharp passage of arms between the veteran critic and the accomplished Consul at Trieste, which appeared in the *Ocean Highways* for June, September, and November 1873, and January 1874. Mr. Cooley there says that "the task of undeceiving the world is a heavy labour for one advanced in years, but that the provocation is great, and that Society is entitled to the whole truth and shall have it." The present pamphlet is, we presume, the result of the above announcement. Its object is stated to be "to examine the character and results of Dr. Livingstone's long-continued wanderings, so as to arrive at an exact appreciation of his merits as a discoverer, and to dissipate, if possible, the delusions which now obscure and disfigure his history." The Royal Geographical Society, as Livingstone's chief friend and supporter, receives very rough handling by the way.

It is unfortunately true that Dr. Livingstone, in one of his letters, did make an attack upon Mr. Cooley which was certainly unmannerly, and apparently unprovoked, and which the object of it characterizes as "an outburst of vulgar ribaldry." The critic is, therefore, quite within his right in making a searching examination of Livingstone's published maps and writings, and in pointing out any errors that he may discover. He does this with an unsparing hand, and with some success. But it is pleasant to find that Mr. Cooley is not blind to the good qualities of the departed explorer, and that he has the generosity to give expression to his opinion.

Mr. Cooley speaks of Livingstone's enterprise with the Makololo as highly meritorious, and characterizes the idea of leading a party of the Makololo to the Portuguese settlements as a bold and happy thought. He adds, "It is in his familiar intercourse with the untaught Africans that Dr. Livingstone appears to advantage; while other travellers speak of their black informants with contempt, he assumes no airs of superiority. He treats them as equals, sympathizes with them, and endeavours to give the proper direction to their enterprising spirit. His journey from the central region to Loanda, and thence to Quilimane, was boldly conceived, and in many respects skilfully executed. It was a very remarkable feat, and its merit was all his own."

We trust that Mr. Cooley will allow this more generous side of his judgment to have fuller play in his future writings. Of his great knowledge of African geography, and of his critical acumen there can be no doubt. We venture to express a hope that he will now set aside all angry personal feelings, and that geographers may yet derive further benefit from this eminent scholar's acquirements and critical insight, without being pained by unprofitable controversies.

FOREST FLORA OF NORTHERN INDIA.*

THIS flora with illustrations, published under the authority of the Secretary of State for India, has been expected for some time, and will everywhere be welcomed with great satisfaction. For many years it has been most desirable, both in the interests of forest administration and of geographic botany, that a forest flora of Northern India should be undertaken, Col. Beddows having lately completed the flora sylvatica of the Madras Presidency.

The late Dr. J. L. Stewart was in the first instance entrusted with the preparation of this work; but his health gave way, and the materials were made over to Dr. Brandis, who will be admitted by those knowing anything of forest matters to be the man of all others best fitted for the accomplishment of the task. His personal knowledge of Eastern arboreous vegetation was acquired when Conservator of Forests in Burma, and during a series of extensive tours since 1863, as Inspector-General of Forests to the Government of India. Many who remember the paper "On the Distribution of Forests in India" published in *Ocean Highways*, October 1872, p. 201, will acknowledge that Dr. Brandis brought no ordinary ability to bear upon the work he undertook. The *Flora* is an octavo volume of 640 pages, and is accompanied by a quarto volume illustrating seventy of the most remarkable trees in North India. The delineations are admirably executed by Mr. Fitch, the well-known botanical artist. In nomenclature and arrangement it resembles the Colonial Floras prepared at Kew. The typography is excellent, and there is a copious index of vernacular as well as botanical names and synonyms, which have been carefully verified.

The geographic limits of country included in this work embrace the Punjáb, the North-West and the Central Provinces. The northern limit is the treeless zone of the inner Himalaya, while to the south the territory is bounded by the open plain which skirts the base of the Satpuræ range. The area extends from about 20° to 35° N. lat., and from 68° to 84° E. long., and includes fertile districts as well as desert tracts.

In the preface the author states that the book "has been written not for botanists but for practical men, especially those who have the care of public forests in the different provinces of India," and it will certainly for a long time to come be used as a text book by forest officers, and by district engineers and English settlers for reference in all points relating to the distribution, size and economic value of Indian trees. The description of the most valuable timber trees contain the results of experiments made by the author and others as to the specific gravity and strength of the wood and the special purposes for which it is best adapted. To show the great amount of varied and accurate information condensed under each species we extract the remarks which follow the description of the *Prunus padus*, or bird cherry.

"Himalaya, between 4000 and 10,000 feet, at times ascending to 12,000 feet from the Indus to Sikkim. Occasionally planted. A widely-spread tree, from North and Central Europe, through Siberia to Amur Land and Kamtchatka, Caucasus, and Western Asia. Deciduous, the mature foliage dark green, turning red

* *The Forest Flora of North-West and Central India:* Commenced by the late J. Lindsay Stewart, M.D., continued and completed by Dietrich Brandis, Ph.D. 8vo. (W. H. Allen & Co.)
Illustrations of the Forest Flora of North-West and Central India. 4to. (London, W. H. Allen & Co.)

before its fall, generally in autumn, sometimes as early as June. Fl. April-June to September. Fr. usually ripens July-October, remains long hanging on the tree.

"Usually found in mixed forests; thrives best in moist places, where it attains 50 to 60 feet, with a girth of 5 to 6 feet. Bark ½-in. thick, brown or purple, fairly smooth, a scurfy tuberculate grey pellicle peeling off. Wood, brownish-white, close and even grained, takes a fine polish. In France it is occasionally used by cabinet-makers. The fruit is sour, with a slight mawkish astringent flavour, but is much eaten by the hill people. In Sweden and Lapland, and some parts of Russia, the bruised fruit is fermented, and a spirit distilled from it. The unripe fruit of this species is often attacked by an insect, and then swells out into a curved hornlike excrescence; hence Wallich's name of *P. cornuta*. Similar excrescences are often found on plum-trees in Europe, particularly on prunes *(Zwetschen)* in Germany. The leaves are considered excellent cattle-fodder."

In concluding this notice we heartily recommend the work of Dr. Brandis, which is calculated in every way to fulfil the purpose for which it was written, and is a mine of exact information on forest questions gathered from many sources, and elaborated with the greatest care.

THE GERMAN POLAR EXPEDITION.*

FROM time to time we have had occasion to notice the successive volumes of this noble report of the German Expedition to East Greenland, or as its promoters, the Polar Committee in Bremen, prefer to style it—"The Second German Polar Expedition," expressing our opinion of the high merit which in general and throughout it possesses. Again, through the kindness of Dr. Lindeman, the Secretary of the Bremen Society, we have received an advance copy of the third volume of the work in question. When we last noticed it we had expected that the next volume would have treated of the geology, astronomy, meteorology, &c., of the expedition, but the exigencies of authorship have apparently compelled this volume to be delayed, for the one now before us is entirely occupied with the narrative of the voyage of the 'Germania,' after parting with the 'Hansa.' It is written by the different officers of the expedition, whom the Committee have permitted—and wisely too—to tell their own tales, and it cannot be denied by the most unfriendly critic—could such an ill-natured creature possibly exist—that though our German cousins, especially *savants*, do not excel in spirited narrative, that this portly volume of four hundred pages (pp. 291—699) contains as interesting a narrative of gallant deeds as have ever come before the public, though naturally it lacks some of that thrilling grandeur which attached to the tale of the ill-fated 'Hansa.' The general drift of the work has already appeared in this journal, and it is impossible to give an outline of its contents, except in such full detail that it would be unjust to a narrative which we hope may yet appear in an English dress, to skim the cream off in this manner. We will, therefore, content us with giving the reader an idea of the character of the contents, trusting that he may hereafter have the curiosity to make himself better acquainted with the work, in either its native or one of its—future—foreign dresses. The work, we might premise, is only the second part of the first volume, which we first reviewed in *Ocean Highways* for April, 1873, and in natural sequence comes before the zoological and botanical section, noticed in a recent number.

In Chapter I. Captain Koldewey and Dr. Pansch—names now very familiar to us—detail the voyage of the 'Germania' from the 21st July to the 5th of August.

Chapter II. is by the same authors, and treats of Pendulum Island, journeys on the ice, scientific daily work, the musk ox, &c. Pendulum Island, on which Sabine made his famous experiments to determine the figure of the earth, is a somewhat quadrangular piece of land, with two capes at either end, giving it what a naturalist would call a "quadricorn" appearance. The two most northern ones are Cape Buchenau and Hartlaub, the most easterly southern one is Cape Desbrome, while the westerly is yet without a name. The interior is very mountainous; Kirchenspitze (the "Church Spire") being 488.7 feet, Sonnenkopf, 616.2 feet, and Stufenberg, 466 feet in height, these elevations being determined by trigonometry. Pendulum Strait separates Pendulum Island from Sabine Island, lying more to the west. The latter is much larger, irregular in outline on the southern and north-eastern coasts, but little indented by bays on its eastern line. Hansa Bay is the largest indentation, while Germania Bay, in which the 'Germania' wintered, is close by Sabine's old observatory. Refersteinberg, Tafelberg, Kronenberg, and Kasenberg, are the highest elevations, being respectively 685.5, 415, 561, and 607.9 feet in height. Cape Neumayer is its most northern termination; Griper Strait separates it from the mainland. From this harbour on Sabine Island sledge journeys were made to the north, lat. 77°, a little to the north of a grim cape, which bears the name of "Bismarck," being reached on the 15th April, 1870. Shannon Island is described by Dr. Copeland and Lieut. Payer (now in joint command of the Austrian expedition, on board the 'Tegethoff'), while Dr. Börgen is the author of that of Pendulum Island. Chapter III. is occupied by Captain Koldewey in describing the voyage of the 'Germania' along the outer coast from 7th to 13th September, 1869; and Chapter IV. with a sledge journey up Fligely-Fjord, one of the numerous inlets which intersect the mainland of East Greenland, and with an exploration of the miocene coal formation of Kuhn Island (14th to 21st September, 1869). In the sixth chapter, Dr. Pansch gets, from a literary point of view, the expedition well into winter quarters on the 13th September, and winter may now be said to have closed on the expedition. All the life-like details which, to those who have gone through a like experience, must forcibly recall the past, are given—the covering in the decks, the warming arrangements, the foxes changing their coats from black to white, the bears sniffing about, wondering what is all the stir, the little lemmings, the dredging, and so on. The signification of some of these discoveries was pointed out when we noticed the zoology of the expedition in a former number. In Chapter VII. Lieutenant Payer describes a sledge journey to Clavering Island, and up the Tyrolese Fjords, which cut the Greenland Coast in lat. 74° 20′, and like all the Greenland fjords, are dismally wild in winter—picturesquely beautiful in summer and autumn. A part of this chapter has already appeared in the Vienna *Wanderer*, and in Petermann's *Geographical Mittheilungen*, 1871, s. 129. Captain Koldewey adds some useful remarks upon

* *Die Zweite Deutsche Nordpolarfahrt in den Jahren* 1869 *und* 1870, *&c.*: Erster Band, Erzählender theil, Bearbeitet von den Mitgliedern der Expedition. (Leipzig: F. A. Brockhaus. London: Trübner & Co., 1874.)

Arctic sledging, an art which may be said to have its home in England, so that any of his hints can add little to *our* knowledge of this necessary accomplishment of an Arctic explorer.

Dr. Pansch describes the life of the Arctic winter in Chapter VIII. An outline of this we gave in our first notice of the expedition. Dr. Börgen contributes in the next chapter an account of how the scientific observers were occupied during the long night, viz., in meteorological, magnetical, and tidal observations, and in a study of the Northern Light. Pansch has Chapter X. allotted to him to describe, in great detail, the first month of 1870; a very little goes a long way when men are trying to kill time during an Arctic winter and spring, and the learned doctor has not made the least of their daily life.

Chapter XI. finds Lieutenant Payer, a pleasant, lively writer, again taking up the narrative. In it he describes the great sledge journey to the north, which we have already referred to, and, again, in memory, he explores King William's Land, as the East Coast of Greenland, explored by the expedition, is cumulatively named. It is needless to say that the German Kaiser is so honoured by his loyal subjects; nor will we deny his right to this compliment. Still it is against all the canons of geography to name two parts of the world, especially two so near each other, by the same name. We have had already a King William Land—to which a melancholy interest attaches, as the region where Franklin's ships were lost—to the west of Baffin's Bay, and now to have another a few hundred miles further to the east, is, to say the least, rather confusing, and might, even at the expense of a little loyalty, been avoided. Would not the "Kaiser," instead of the "König" "Wilhelm's Land" have done equally well from both a loyal and nomenclatural point of view, beside being politically more correct?

In Chapter XII. is detailed another sledge journey made between the 8th and 29th of May up Ardencaple Inlet, in which Payer is again the leader and the writer. A chapter of much interest to sportsmen is the XIII.—"Hunting and Animal Life in Greenland," by Payer and Copeland: the bear, the reindeer, the hare, &c., are described from a sportsman's point of view; while Dr. Hartlaub adds a very learned and valuable article, detailing everything we as yet know of the history and distribution of the musk ox, or rather musk *sheep*, as it in reality is. Drs. Copeland and Börgen give in Chapter XIV. an account of the various sledge journeys made in the spring of 1870; and, in the one which follows, Captain Koldewey narrates his attempt to proceed to the north, a voyage which commenced on the 22nd and ended on the 30th July, in lat. 75° 29′ N. In Chapters XVII. and XVIII. Koldewey, Pansch, and Payer narrate the coast voyage of the 'Germania' to the south, and the exploration of the Kaiser Franz-Joseph's Fjords. The last great inlet, or rather series of interlacing inlets, cuts Greenland in lat. 73° 12′, and has been explored for about eight degrees of longitude (to 30° W.). The land on either side is of great altitude, Petermann's Spitze being 3480, and Payer's Spitze 2200 in height. Glaciers—offshoots of the great interior ice of Greenland—pour down the mountain valleys, while lesser (?) inlets pass off on either side. It is, however, a mistake to suppose, as was at one time done, that this inlet stretches across Greenland to the West Coast; if it does so, at all events its western termination is not within the known limits of Greenland, for though some of the fjords of West Greenland have not been thoroughly explored, the easterly termination of all of them are well known.* Professor Buchenau contributes a popular sketch of the more common Greenland flowers, to illustrate which there is an exquisitely coloured plate of a bouquet of Greenland plants. Lastly, Captain Koldewey brings his good ship home to Bremerhaven, where we leave him, with all the good wishes that a brave man and a good sailor deserves, and only this compliment—and it is no compliment but only the plain truth—that he can tell his story, in simple sailor fashion, as agreeably as he can explore gallantly. He may have had companions more learned than he: on board the 'Germania,' there was no one more intelligent than her commander.

Though in a future number we may have something to say of the concluding part of the scientific section of this work when issued, still as the narrative and some popular portion of the book is now finished, we may add, in concluding this brief review, that the narrative of the second German Polar Expedition is no ordinary work: it is marked by all the thoroughness and exhaustiveness of everything which emanates from Germany—possibly also a little by the heaviness of things Teutonic. Still that in a book of this sort is not a fault. The work is not a "popular" one in the ordinary acceptance of the term: it is a thoroughly scientific narrative—in no portion is anything left to be desired for. Scarcely a topic is touched upon which is not exhausted, and no feature of such an expedition is left unnoticed. The staff of able scientific men ensure the accuracy of the statements in regard to the matter which come under their cognizance, and the book in this respect affords a pleasant contrast to the painful trash which some so-called explorers with *no*, or what is worse, with a *little* inaccurate scientific knowledge inflict upon a long-suffering world. This work of many authors—but yet with a single individuality—will live as a monument of patient labour by brave men, long after the "Slidings after Sledges" and "Scrambles in Scribble land" have disappeared in instalments round tobacco and butter.

The narrative is illustrated by many admirable wood engravings and several plates printed in colours. Some of these are of a very high character, artistically and descriptive, and though there is nothing sensational in any of them, yet some, even to those who know and care nothing about Arctic explorations, will be looked on with keen interest. Six maps accompany the part under review, viz., a general map of Greenland showing the explorations and routes of the Expedition, by Herr Reinert; a special map of the Tyrolese Fjords, by Payer; East Greenland between 73° 30′ and 76° N. lat., by Payer; a chart of Pendulum Island by the same accomplished explorer; a small map of the Kaiser Franz-Joseph's Fjord; and a little sketch of the northern part of East Greenland, to show the route of the sledge expedition undertaken between the 24th March and 27th April, 1870. All of these maps and charts are executed with Brochau's well-known skill, and with the exception of the last two are on a very large scale. ROBERT BROWN.

* The reviewer has discussed this in his memoir, "Das Inner der Grönland."—Petermann's *Geog. Mittheilungen*, Oct. 1871.

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Cartography.

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Indian Maps.

It is satisfactory, above all things, to be able to report that the publication of the Indian Atlas* is progressing at an ever increasing speed, no less than eight new sheets having been issued since our last notice, besides which a carefully revised edition of one sheet has been published. The principle observed in the preparation of the Indian Atlas appears to be that no portion of unsurveyed country shall be delineated, and this accounts for the blanks which appear on some of the maps now before us. On sheet 2 S.W. (Karrachi and environs) only the British territory is shown; on sheets 9 S.E. (part of Khyrpur, in Sindh) and 33 S.E. the unsurveyed portions of Rajputana are omitted; on sheet 53 S.E. (Hoshungabad) the adjoining portion of Bhopal remains a blank; on sheet 87 N.E. (part of Audh) the neighbouring parts of Nepal; and on sheet 124 N.W. (Assam) those of Bhutan are not delineated. These blank spaces may probably cause some annoyance to persons using the Atlas, though they, too, will admit that it is preferable to publish the sheets in this unfinished state to postponing their publication until the whole of the country falling within their margin shall have been surveyed. In addition to the sheets already mentioned there remain to be noticed sheet 3 N.E. (a portion of the Delta of the Indus), and sheet 125 N.W., with a portion of the Khasia Hills, of Sylhet and Cachar. The latter is one of the most favourable specimens of the Atlas, the hills being very fully delineated from surveys made by Lieut. H. L. Thuillier, Mr. N. T. Davey, Captain H. H. Godwin-Austen and others. Sheet 68, originally published in 1848, has been thoroughly revised, and partly re-engraved. It represents a portion of Audh.

Sheet 11 of the smaller map of the Khasia and Garrow Hills† has been published, and a second edition of sheet 16-17 of the one-inch map issued. The former is based upon surveys made in the years 1866 to 1869 by Captain H. H. Godwin-Austen, Lieut. R. V. Riddell and others. It is crowded with hills, and the almost entire absence of villages is truly remarkable.

Of Topographical and Revenue maps on a scale of one-inch to the mile, no less than twenty-five large sheets have been added to those already in existence, and for nearly one-half of these we are indebted to the officers of the Great Trigonometrical Survey of India, who are charged with the survey of native states.

The map of the district of Lohardugga in the sub-division Palamow of the Lower Provinces‡ will be completed in fifteen sheets, of which only three (7, 8, and 10) have been published. The sheet now under notice is drawn from surveys made by Major G. H. Thompson, Capt. J. Sconce and others, in 1864-68, and 1871-2,‖ and the hills are very neatly laid down upon it. The revenue survey of the Kooch Behar state will be completed in seven sheets, of which five (1, 2, 3, 4 and 7) have already been issued. Sheet 7, just to hand, is from surveys by Mr. J. H. O'Donel and others. Passing over from the Lower to the North-Western Provinces we meet with the first three sheets of a Revenue Survey map of the District of Bijnour in the Province of Rohilkand.* The map, as far as published, is based upon surveys carried on between the years 1863 and 1870 under the superintendence of Major A. D. Vanrenen; it is very neatly photo-zincographed and elaborately coloured, and many altitudes, partly based upon spirit levelling, are indicated. The Rajpootana Topographical Survey† has supplied us with one more sheet from surveys made in 1871-72, by Captain G. Strahan and Mr. H. Horst, and out of a total of 253 sheets as many as forty-four have now been published. The progress of the Topographical Survey of the North-Eastern Division of the Central Provinces‡ has been more rapid, for no less than five sheets have been issued since our last notice. Four of these sheets (viz., 7, 8, 10, and 14), are based upon surveys made in 1870-72, by Major G. C. Dupree and assistants, the fifth (15) exhibits the results of Lieut. M. T. Sale's labours (1871-72). Crossing over into the Presidency of Bombay, we meet with three new sheets of the Sindh Revenue Survey of Oomerkot and Khyrpoor,‖ for which we are indebted to Captain D. Macdonald and Mr. W. Lane, whose labours, however, date back partly as far as 1860, a delay in the publication by no means usual in the case of Indian surveys. Out of a total of 102 sheets, there have been published up to the present time no less than seventy. Far more important are the contributions of the officers of the Great Trigonometrical Survey, who have undertaken to supply us with correct maps of the Guicowar's territories. The survey is being carried on by two distinct surveying parties, the one for Kattywar, being in charge of Captains H. Trotter, R.E. and A. Pullan, the others for Guzerat, in that of Colonel D. Nasmyth and Major C. T. Haig, and the whole being conducted under the superintendence of Colonel J. T. Walker. The surveys are being published on a scale of one inch to a mile. The map of Guzerat will be completed in eighty-two sheets of large size, of which three have been published.§ They are the result of surveys carried on in the years 1870-71, and amongst the gentlemen employed on that service there were Mr. J. Hickie, Mr. Christie, Mr. Goslin, Mr. Connor, Captain Pullan, Mr. C. McA'Fee and others. The map of Kattywar¶ is much further advanced, for out of a total of sixty-one sheets as many as eighteen have already been issued to the public. The sheets now under notice embody the results of surveys made in 1870-73, the principal officers employed being Captain H. Trotter, Messrs. E. N. Wyatt, J. McGill, F. W. Ryall, N. C. Gwynne, T. H. Rendell, and W. A. Fielding. These topographical maps of the "Great Trigonometrical Survey" need not fear comparison with similar maps issued by other Indian Survey Departments. They distinguish between metalled roads, country roads, and foot-paths, show cultivated and waste lands, give the number of houses in each village, and numerous altitudes. They are neatly drawn and photo-zincographed at Dehra Dun. In spelling the names

* Indian Atlas. Sheets 2 S.W., 3 N.E., 9 S.E., 33 S.E., 53 S.E., 87 N.E., 124 N.W., 125 N.E., and a new edition of 68. Calcutta, 1873.

† Khasia and Garrow Hills Topographical Survey. Scale 1 m. = 1 inch. Sheets 16 and 17 on one sheet. 2nd edition. Calcutta, 1873. Khasia and Garrow Hills Topographical Survey. Scale 2 m. = 1 inch. Sheet 11. Calcutta, 1873.

‡ Palamow Revenue Survey. Sub-division Palamow, District Lohardugga. Sheet 10. Calcutta, 1874.

‖ Lower Provinces Revenue Survey. Kooch Behar State. Scale 1 m. = 1 inch. Sheet 7. Calcutta, 1874.

Index to the sheets of Kooch Behar State. Scale 4 m. = 1 inch. Calcutta, 1872.

* North-West Province Revenue Survey. District Binjour. Scale 1 m. = 1 inch. Sheets 1, 3, and 6. Calcutta, 1873. To be completed in 7 sheets.

Index to sheets of District Bijnour. Calcutta, 1873.

† Rajpootana Topographical Survey. Scale, 1 m. = 1 inch. Sheet 41. Calcutta, 1874.

‡ North-East Division Central Provinces Topographical Survey. Scale, 1 m. = 1 inch. Sheets 7, 8, 10, 14, and 15. Calcutta, 1873.

‖ Sindh Revenue Survey. Oomerkot and Khyrpoor State. Sheets 44, 73, and 77. Scale, 1 m. = 1 inch. Calcutta, 1874.

§ Great Trigonometrical Survey of India. Guzerat Topographical Survey. Scale, 1 m. = 1 inch. Sheets 11 and 13, and 2nd. edition of sheet 12. Dehra Dun, 1873 and 1874.

Index Chart of the Guzerat Topographical Survey, 1 inch = 24 m. Dehra Dun, 1873.

¶ Great Trigonometrical Survey of India. Kattywar Topographical Survey. Scale, 1 m. = 1 inch. Sheets 10, 11, 20, 21, 22, 23, 24, 29, and 30.

the Hunterian system of spelling has been adopted, as far as we know, for the first time on any official Indian map, although the order for introducing that system dates some time back. We trust that the laudable example given in this respect by Colonel Walker, may soon find imitators in other government departments, for although there may be shortcomings in the system recommended by Dr. Hunter, and some small inconvenience in applying it to well-known places (the names of which might however be written according to the old style, and placed in brackets), there is no doubt of its superiority to the arbitrary modes of spelling now in use.

The officers of the Revenue Survey, in addition to supplying us with a number of one-inch maps, have likewise produced plans of two cantonments and civil stations. That of Tezpoor,* in Assam, was surveyed by Captain J. H. W. Osborne, in 1871-72: that of Dibroogurh,† by Lieutenant W. Barrow, in 1867-68.

But far more interest will probably be attached to the Trans-frontier maps,‡ compiled under the orders of Colonel J. T. Walker and Major T. G. Montgomerie, from route surveys and astronomical observations made by British and Asiatic explorers from the side of India, than to these plans or even to the Topographical and Revenue maps. The former, drawn on a scale of 16 miles to the inch, show roads, the British boundary, and all points determined trigonometrically, but no hills. The insertion of these would certainly have obscured many of the features of the maps, and numerous altitudes compensate, at least in part, for this omission. Sheet 8 comprises the country between latitudes 30° and 35° N., and longitudes 77° and 86° E. It embraces thus Kashmir and a large portion of Tibet. The other map, sheet 4, extends over one of the most interesting portions of Asia, for it embraces portions of Persia and Afghanistan, inclusive of the whole of Badakhshan (the eastern extremity of Wakhan alone excepted). Major Montgomerie has embodied in this map a great deal of fresh matter, as must freely be acknowledged by anyone acquainted with the geography of that part of the world; but he has, nevertheless, failed to utilise the whole of the existing information which is available even to persons to whom access to the Indian archives is not vouchsafed. We should, for instance, have liked to see the passes leading to Banian more correctly laid down, which might easily have been done had the accounts (as distinguished from the maps) of Wood, Masson, Burslem and others been consulted. Badakhshan, too, does not come up to our expectations. Faiz Baksh's account contains sufficient data for laying down the districts constituting that country, and the large manuscript map of the country between Peshawur and the Oxus, prepared by a native explorer, employed by Mr. Ommaney about 1869, contains much additional information, which has been disregarded. It shows, for instance, that Rustak, the great commercial town of Badakhshan, does not lie on the Oxus, but some distance to the north of it. We regret the omission of political boundaries, but we can understand the reasons which induced Major Montgomerie to take that course. In fine, Major Montgomerie's map may fairly claim to be the best and most complete one of that portion of Asia hitherto published, and politicians studying the Central Asian question can hardly do better than procure a copy of it.

E. G. RAVENSTEIN, F.R.G.S.

* Lower Provinces Revenue Survey. Cantonment, Civil Station, and Environs of Tezpoor. Scale 6 inches = 1 m. Calcutta, 1873.

† Dibroogurh Cantonment, Civil Station, and Environs. Scale 6 inches = 1 mile. Calcutta, 1873.

‡ Great Trigonometrical Survey of India. Trans-Frontier Maps. Skeleton Sheets 4 and 8. Scale 16 m. = 1 in. Dehra Dun, 1873.

Log Book.

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The Arctic Expedition.—On Saturday, August 1st, the President of the Royal Society, the President of the Royal Geographical Society, and Admiral Sherard Osborn had an interview with Mr. Disraeli on the subject of the Arctic Expedition in 1875; entering upon the important scientific and commercial results to be obtained, the great advantages of such enterprises to the naval service, and the practical details. The Prime Minister asked numerous questions, and promised to read the papers that were left with him, and to consider the subject carefully with a view to an early decision.

Height of Lake Tanganyika.—The Royal Geographical Society having retained the certified "Index Errors" of the instruments used by Lieutenant L. V. Cameron, R.N. (which were made at the Kew Observatory and at the Royal Geographical Society), will thus render these observations the most complete that have ever been made either on or near these African lakes.

On February 27th, 1874—7 A.M. at Ujiji, seven boiling-point thermometers * were used, which, corrected for Index error, gave the mean result as 207°.54, the corresponding barometric reading is 27.36 inches, temperature 82°.2.

On February 28th, 1874—7.30 A.M. at the same place, two of Captain George's Mercurial Barometers, filled on the spot, gave a mean of 27°.35, temperature 74°.†

With the above data, using the barometric sea-level of 29.92 inches,‡ and the coast temperature for February and the same latitude of Ujiji, as given by Dové, the result of computation is as follows:—

February 27th, 1874, Lake Tanganyika, Ujiji,
7 B.P. thermometers, give ... ... 2710 feet.
February 28th, 1874—Lake Tanganyika, Ujiji,
2 CaptainGeorge's Mercurial Barometers ... 2711.2 feet.

The first part of Lieutenant Cameron's journal not having come to hand, the result of the four Aneroids is not attainable on account of their having been re-numbered at Kasé, and the former numbers omitted.

Obituary.—DR. C. T. BEKE, F.R.G.S., F.S.A., &c. The recent death of this gentleman, who was well-known for his geographical labours, deserves a record in these columns. Dr. Beke gained the gold medals of the Royal Geographical Society, and of the sister society in France for his exploration of Abyssinia from 1840 to 1843, during which period he fixed by astronomical observations the latitude of more than 70 stations, roughly mapped about 70,000 square miles, and collected dialects and vocabularies of thirteen languages and dialects spoken in the country. The information acquired by him subsequently proved of signal service on the occasion of the Abyssinian Expedition. Dr. Beke was the editor of that volume of Hakluyt series which is devoted to old Gerrit de Veer's "Three Voyages by the north-east towards China and Cathay," to which such keen interest has attached itself since the discovery of Barents' hut on the north-

* All by Casella, Optician, Holborn.

† Made by Gould and Porter, 181, Strand.

‡ In all previous observations, this sea-level has been used.

east coast of Novaya Zemlya. Dr. Beke also paid great attention to the investigation of Biblical topography, and his recent work, in which he contended that the true Mount Sinai was a volcano situated east of the Gulf of Akabah, has been already noticed by us (*Ocean Highways* for August 1873). He died in the seventy-fifth year of his age.

Indian Marine Surveys.—In order to provide for the resumption of this crying want, arrangements have been made for the organization of a small survey flotilla, which will consist of one steam tender, three brigs, two schooners, and five steam pinnaces, with competent surveyors and efficiently manned. The following vessels have been selected for this service. The gun-boat 'Clyde,' a steamer belonging to the Bombay Government of 300 tons and 60 horse-power (nominal); two old teak-built pilot brigs of 300 tons, the 'Guide' and the 'Megna'; the 'Marie' a teak-built schooner, on board of which Captain Constable did his surveys in the Persian Gulf from 1858 to 1860; and a very small schooner called the 'Augusta." Two of the steam-pinnaces will be built at Calcutta for 300*l.* each. They will be 28 feet long by 7, with engines of three horse-power, and will hoist inboard. Two others are to be built in this country.

Introduction of Tobacco into India.—There is an interesting account of the introduction of the use of tobacco into India, in the forthcoming volume of *Elliot's Muhammadan Historians* (vol. vi.). Asad, the narrator, says that he found some tobacco at Bijápur, and presented it, in a beautiful pipe, to the Emperor Akbar. His Majesty inquired what it was, and was told that it was tobacco, a medicine well known in Mecca and Medina. He began to smoke it, but his physician interposed, saying that it was an untried medicine about which the doctors have written nothing. Akbar replied—"Truly we must not reject a thing that has been adopted by the wise men of other nations merely because we cannot find it in our books; or how shall we progress?" Asad had brought a large supply of tobacco, and distributed it among the nobles of Akbar's court, and the practice of smoking was introduced. After that the merchants began to sell it, and the custom of smoking tobacco rapidly spread. Akbar himself, however, did not adopt it.

Indian Pendulum Observations.—The Indian pendulum observations, which have just been brought to a conclusion at Kew, were first instituted in 1864, by Colonel Walker, the Superintendent of the Great Trigonometrical Survey of India, with the permission of the Secretary of State. Many of the most eminent Fellows of the Royal Society also supported the scheme, on the ground that it afforded an independent check on the local variations in the direction of the force of gravity, and on the disturbances due to the mountain masses to the north of India; that it threw light on the density of the earth's crust, as well as on the figure of the earth; and that generally speaking, it was a necessary part of any extensive geodetic operations. For the purpose of the experiments, the Royal Society lent an astronomical clock and two invariable pendulums, and this equipment was supplemented by a copper vacuum cylinder and an air pump. It was decided to make Kew Observatory the base station in this country for the operations, and before the pendulums were sent to India, they were swung there by Mr. Loewy. The apparatus arrived in India in 1865, and the work was at once commenced by Captain J. P. Basevi, R.E., who had been placed in charge. In the course of the next five years Captain Basevi swung the pendulums at some nineteen stations on the Indian arc from Dehra Dun to Cape Comorin, at two stations on the East Coast, and at two on the West Coast of India, and he likewise swung them at Minicoy, an island of the Lakhadivh group. In 1870, two convertible pendulums were lent to Colonel Walker by the Imperial Academy of Sciences at St. Petersburg. These pendulums had been used on the Russian arc, and it was hoped that by their means a connection might be established between the Indian and Russian pendulum operations. An arrangement for measuring the lengths of these pendulums form part of the whole apparatus, so that they are capable of giving not only relative results, such as are obtained by the invariable pendulums, but also absolute values of the length of the simple seconds pendulum. Captain Basevi had at that time but little opportunity of using these pendulums, and in the spring of 1871 he started for the lofty plateaux of Tibet, taking with him the invariable pendulums only. On his way thither he took observations at Mian Mir, and from thence ascended to the Rukshu and Ladak. Here, at altitudes of 15,500 and 17,000 feet respectively, he continued his observations; but the severity of a climate where the thermometer rises to 70° or 80° in the afternoon, to fall below Zero at daybreak, proved unfortunately fatal to this gallant and able officer.

Captain Heaviside was subsequently appointed to complete the operations. After some preliminary observations at Dehra, and at Mussoorie, he went to Kaliana, the base station in India for the pendulum experiments. He there took observations with the invariable pendulums to determine whether they had undergone any change since they were last swung there. He also swung and measured at Kaliana the Russian convertible pendulums. He then started for England, and on his way to this country he swung the pendulums at Bombay, at Aden, and at Ismailia in Egypt. At the Kew Observatory, he has swung the invariable pendulums, to determine whether they had undergone any alteration since 1865, and he has also carried out there a complete series of experiments with the Russian convertible pendulums for the determination of the length of the simple seconds pendulum.

At the suggestion of General Sir E. Sabine, a further series of experiments is being made with the convertible pendulum employed in 1818 by Captain Kater. The bar of this pendulum, owing to some unknown cause, had become bent. The bar has been re-straightened, and the knife-edges re-ground and re-bedded. In its thus altered condition this pendulum has been swung at the Kew Observatory, by Captain Heaviside; and Lieut.-Colonel A. R. Clarke, R.E., has undertaken to measure the distance between the knife-edges of the pendulum at Southampton. From the value thus obtained, a second determination of the length of the simple seconds pendulum at Kew will be made. Captain Heaviside will shortly return to India where the final results of the whole series of experiments from 1865 will be computed out and arranged for publication.

Chinchona Cultivation in Ceylon. — The demand for chinchona plants in Ceylon is now so great that it is found to be very difficult to meet it from the Government nurseries at Hak-galle. In his Report dated March 28th, 1874, Mr. Thwaites says that, during the year 1873, applications were made to him for 720,000 chinchona plants, and that 670,500 were issued. This will give some idea of the activity going on in the cultivation of chinchona in Ceylon. Moreover, many planters are now forming nurseries of their own for the propagation of plants from seeds and cuttings.

Publication of Mr. Burgess's Report on his Archæological Work in India.—The India Office has resolved to print the account of Mr. Burgess's recent researches in the Bombay Presidency, together with its accompanying illustrations. The report contains an exhaustive notice of his discoveries at Belgam, Konur, and Badami, at which latter place are some highly interesting sculptured caves, a complete delineation of which, with a few casts, would form a valuable illustration of Hindu art and Vaishnava mythology—only to be rivalled by what Ajanta affords of Buddhism. Mr. Burgess has brought home altogether fifty-four photographs, between twenty-five and thirty rubbings of inscriptions, about forty ground plans, sections, and drawings of columns, &c., and forty sketches of sculptures.

Correspondence.

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THE CAMERON SEARCH EXPEDITION.

THE following letter from Lieutenant Cecil Murphy, R.A., finally sets at rest the ungrateful controversy as to whether it was owing to aid given by Lieutenant Cameron's Expedition, that Dr. Livingstone's body and effects were sent down in safety to the coast :—

SIR,—Being home from India on sick leave, I have been asked by several persons "in the interest of my friend Lieutenant Cameron, R.N., of the truth, and of my own character," to write to you on the subject of the correspondence that has appeared in the *Times* respecting the Cameron Livingstone Expedition. I should have done so before now but that I had not the whole of the correspondence before me.

A short account of what actually occurred will be better, I think, than any expression of opinion from me.

The first intimation that we—Lieutenant Cameron, the late Dr. Dillon, and myself—had of the death of Dr. Livingstone was a letter written by Jacob Wainwright, without any address, which was brought to Cameron by Chuma. He, hearing that there were white men in Unyanyembe coming up to help Dr. Livingstone, very naturally supposed that his son must be one of the number. Chuma informed us that his caravan was some four marches distant; that the men were starving and naked, and unable to move from the want of anything wherewith to purchase food, and in their name he begged for assistance. Cameron sent him back, giving him a bale of cloth, good Merikani, one of the last two or three bales of that description that we had, and one of the last eight, as well as I remember, that we had of any kind. This assistance enabled the caravan to come on.

It was the wish of the men, and a very natural one, to stop and rest themselves at Unyanyembe, and besides supporting them while there, Cameron gave them a large supply of cloth and beads for their down journey, most of which was, however, spent in riotous living, the camp becoming a scene of drunkenness from morning till night, before they started. For all that Mr. Thomas Livingstone says of their having good credit with the Arabs, I have no hesitation in asserting that had it not been for the presence of our Expedition at Unyanyembe, neither Susi nor Chuma, nor any of the others, could have obtained supplies on credit, and they would therefore have been unable to continue their march to the coast, all their stores being exhausted; for to pass through the country of the Wagogo without paying tribute is an impossibility. It is not likely that Sayed bin Salim al Lamki, the Wali or Civil Governor of Unyanyembe (under Sayed Bargash of Zanzibar nominally), the man whom Dr. Livingstone described as the head of the slave ring or *coterie* there, the man who had always prevented his letters reaching the coast because he supposed them injurious to the great slaving interest, and without whose consent no sales or purchases are or can be made there, would have allowed or assisted the caravan to pass quietly to the coast, carrying papers that he believed would do great injury to himself and the slave trade. Can any one believe that a man described by Livingstone as being so crafty could have been such a fool, when he could have stopped them by simply withholding the supply of stores on credit? It is therefore a fact not admitting of argument, spite of Mr. Thomas Livingstone's inuendoes, that to the presence of Cameron's Expedition at Unyanyembe at the time is due the fact of his father's remains and papers having been safely brought through that place, and equally so that my own presence subsequently enabled them to travel unmolested through the country between there and the coast. Not that I personally, constantly ill with fever as I was, could have done very much to protect them, but the mere fact of a white man's presence helped to insure their safety. I do not claim any credit for this, nor does it detract from the merit of the negroes.

As I have said, nearly all the stores given to Susi by Cameron were spent at Unyanyembe in drink. Within 40 miles of that place Susi informed me that he had not enough for more than a week's march further. He was openly and loudly accused by the other negroes, who were in open mutiny against him, which I with difficulty quelled, of having misapplied the stores given for all to his own benefit. I had to send back to Unyanyembe to bring more stores on credit for both them and myself (some of my own having been stolen). Without this they could not have proceeded, and without me they would not have got it. In point of fact Susi did try, and failed. With regard to the *ruse* practised of concealing the body of Dr. Livingstone as a package of cloth, I believe firmly that in no other way could the portion of country occupied by the Wagogo, and from there to the Kingani, have been traversed, so great is the superstition of the people about corpses and witchcraft. The credit of this proceeding is due to Issa, the interpreter, well-known on the Zanzibar station in the navy, one of Cameron's men, who was returning with me, as he and "Bombay" could not be got to agree.

It had been intended that Chuma and some others should start for Ujiji. This shows that they at any rate attached some importance to what had been left there by Dr. Livingstone. Their chief object, however, as detailed by them at the time to me, was to secure two bales of cloth left there, which was all they depended on for getting down to the coast. Cameron gave them cloth in exchange for this as he was going to Ujiji, and they abandoned the idea. If they had attempted the journey of course it is impossible for me to say what would have happened. But I do not believe, judging from the state of the surrounding country, that they would ever have reached Ujiji. The Arabs themselves were unable to break through Mirambo's forces, and except at one point—to the south—they were hemmed in by him

on every side. We found out this to be the true state of matters when we were in Unyanyembe. The rumours that we heard when even only four days' march off were absurdly contradictory, and it was one of these I suppose reaching the Consul at Zanzibar which he repeated, to the effect that the country was perfectly clear. Those who were with the advanced brigade in Abyssinia will remember the similar contradictory rumours about King "Todorus" and his doings, and how much reliance is to be placed on native report. With both Mirambo and the Arabs against them, I believe it would have been simply impossible for them or any one else, without the moral force given by the unwonted presence of a white man (which has enabled Cameron to do it) to get to Ujiji from Unyanyembe. Whether the map and the journal secured by Cameron are of any value or not—a question which cannot be answered till they arrive home—I think it would have been in better taste for Mr. Thomas Livingstone not to have been the first to undervalue the efforts of a stranger, made at the imminent risk of his own life, to secure what may be an extremely valuable relic of his father.

It is stated on the authority of Susi and Chuma that the caravan would have reached the coast much more easily and quickly if they had not been hindered by having to escort Dr. Dillon and myself. I have already stated that I believe without my presence—poor Dillon having died a few days after we started, to my inexpressible grief—they would never have reached the coast at all. It only remains for me to add what was the actual delay caused by our presence. On three days poor Dillon was too ill to travel, and I had to delay the caravan another day to bury him. I also on two occasions was unable to travel so far as Susi wished from fever. If against this is placed the amount of assistance I gave—as any European in my place would have done—in insisting in going on when they (for negroes are not quite faultless) wanted to stop behind where pombé was plentiful, and the votaries of the sable Venus were kind, and in quelling discontent and keeping the men together when they would have deserted each other, but were sure that a white man would not see them wronged, I think I may fairly claim the balance to be in my favour.

There is one more subject on which I must touch. Mr. Stanley writes to me—"There is a rumour you have resigned. If so, there must have been some great reason. Why not write a book and convert people to your own view?" Others write of me that I "left my work unfinished at Unyanyembe;" "One has resigned," and so on. As the cause of my original resignation was a private matter, and as my action in so doing has been declared by the Council of the Royal Geographical Society to be perfectly satisfactory, I did not intend ever to bring this matter before the public. A number of rumours having got about concerning me, however, I think that I am bound, in justice to myself, and the regiment to which I have the honour to belong, to state what really occurred.

On the arrival of Dr. Livingstone's body at Unyanyembe, I, considering that the great end and aim of our expedition—to render him some service—was no longer possible to accomplish; finding myself almost useless to Cameron for further exploration from my state of health; thinking that one European at least should accompany the late traveller's remains and papers to the coast; knowing that my absence would make the somewhat limited stores with the expedition last much longer (for, though I was to pay all my own expenses, a cheque on my agent was of little use in Central Africa), and, for another reason, into which it is not necessary to enter, I thought it my duty to resign, however bitter it might be after going so far, and I did so. A few days afterwards, Dr. Dillon became so ill that he determined to return to the coast, as the only chance for his life, instead of proceeding. I at once asked that my resignation should be cancelled, not thinking that Cameron should be left alone in such a country, and waived my former reasons for returning before this greater one for going on.

Though I strongly pressed it, however, Cameron would not have it so, saying, he found he had, after supplying Dillon, about enough stores for himself, but not for two. Thus, although I did, at one period, resign the expedition, for reasons considered "perfectly satisfactory" by the Royal Geographical Society, I did eventually leave it very much against my will, and it cannot be said that I "left my work unfinished at Unyanyembe."

In conclusion, let me hope that this statement will induce Englishmen to support their gallant young countryman, now working in that far distant land. All he wants to ensure success is a sufficiency of funds. Stanley is going out amply provided for. Let not the public withhold from our countryman that assistance which alone can avail him, while an American, for whom, at the same time, I have the warmest feelings and good wishes, is from a private source amply provided with them. No better sentiment could be written on this subject than Mr. Clements Markham's observation, that "Englishmen applaud; let them now insure success."

[With reference to Mr. Thomas Livingstone's insinuation, in the *Times* of August 10th, that Dr. Livingstone left plenty of cloth at Unyanyembe which would have enabled his followers to reach the coast without further aid, the truth is as follows:—Dr. Livingstone left four bales of cloth at Unyanyembe; Lieutenant Cameron recovered them with great difficulty from the man in whose care they were left, and gave them to Susi; they were expended by Susi in drink: and the Cameron Expedition furnished the supplies for conveying Dr. Livingstone's body and effects, with his servants, to Zanzibar.]

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To the Editor of the "GEOGRAPHICAL MAGAZINE."

SIR,—With regard to Mr. Michell's letter at p. 214 of your August number, I beg to say that in the letter therein referred to I had, by a slip, written Veniukof instead of Semenof. Mr. Michell is mistaken, it appears to me, in supposing that he *distinctly* named D'Ohsson as his authority for the identity of Karakorum and Bela-sagun; in fact, I supposed from the way the reference to D'Ohsson was introduced that the latter was distinctly *excluded* from responsibility for that identity, but quoted for the identity of *ordu balik* only, and I had not the book to refer to.

I do not make out clearly to what Mr. Michell alludes when saying in the note below that I seemed in one passage to assent to the identity of Belasagun and Karakorum. I should like to make this clear.

Balghasun is a Mongol word apparently meaning city;* (perhaps "walled city," but I have no access to a dictionary). In that sense Kara Balghasun seems to be applied to Karakorum, "the Black Town."

Belasagun again (never mind its etymology) is applied as a *proper name* to a certain specific city of Central Asia by certain Muhammadan writers.

It is very likely that this proper name was, as has been suggested, merely a misunderstanding and corruption of the common noun Balghasun, "city," parallel to the well-known etymology of Stambúl.

But it is quite a different thing to say that Karakorum was the same as Belasagun; to that I have given no colour of assent.—Yours faithfully,

H. YULE.

PALERMO, *August 8th*, 1874.

* It is, I presume, a derivative from *Baligh*. *Asun* is, one sees, a common Mongol termination, but I do not know its force. For instances of the use of Balghasun for "town," see notes to *Marco Polo* I. 261, 269, and II. 7.

Proceedings of Geographical Societies.

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BRITISH ASSOCIATION.

SECTION E.

Thursday, August 20th.

THE Geographical Section (E) met in the Presbyterian College, Belfast, on the above date, when the President, Major Wilson, R.E., took the Chair. The Vice-Presidents were Sir Bartle Frere, G.C.S.I., K.C.B., F.R.G.S.; Admiral Ommanney, C.B., F.R.S., F.R.G.S., and Major-General Strachey, F.R.S., F.R.G.S.; and the Secretaries, E. G. Ravenstein, F.R.G.S., F.S.S.; E. C. Rye; and J. H. Thomas, F.R.G.S.

THE PRESIDENT'S ADDRESS.

THE PRESIDENT, in his opening address said he believed it was usual in the addresses to this section to select some special subject; he therefore begged to call attention to the influence which the physical features of the earth's crust have on the course of military operations; to the consequent importance of the study of physical geography to all those who have to plan or take part in a campaign; and to the contributions to geographical science that are due, directly or indirectly, to war, and the necessity of preparing for war. To show how varied are the conditions under which war has to be carried on, and how much its successful issue may depend on a previous careful study of the physical character of the country in which it is waged, it is only necessary to remind you of the recent operations on the Gold Coast, brought to a successful issue in an unhealthy climate, and in the heart of a dense tropical forest, where an impenetrable undergrowth, pestilential swamps, and deep rivers obstructed the march of the troops; of the Abyssynian expedition, landing on the heated shores of the Red Sea, and thence, after climbing to the lofty frozen highlands of Abyssinia, working its way over stupendous ravines to the all but inaccessible rock, crowned by the fortress of Magdala; of the march of the Russian columns across the steppes and deserts of Central Asia to the Khivan oasis, one month wearily plodding through deep snow, the next sinking down in the burning sand, and saved from the most terrible of disasters by the timely discovery of a well; and, lastly, of the great struggle nearer home, the last echoes of which have hardly yet passed away, when the wave of German conquest, rolling over the Vosges and the Moselle, swept over the fairest provinces of France. The influence of the earth's crust on war may be regarded as twofold: first, that which it exerts on the general conduct of a campaign; and, second, that which it exerts on the disposition and movement of troops on the field of battle. Military geography treats of the one, military topography of the other; and it is well to keep this broad distinction in view, for as with strategy and tactics, they stand in such close relation to each other that it is not always easy to say where geography ends and topography begins. Of special importance in the first case are great inequalities or obstacles that confine or obstruct the movement of large bodies of troops, and those features that retard or accelerate their march. The climate of the theatre of war must always have an important influence on military operations, and should be the subject of careful study. Our own experience in the Crimea shows how much suffering may be caused by want of forethought in this respect. General Verevkin's remarkable march of more than 1000 miles, from Orenburg to Khiva, with the thermometer ranging from 24° below zero to 100°, without the loss of a man, shows what may be accomplished with due preparation. Nor should the geological structure of a country be overlooked in its influence on the varied forms which the earth's crust assumes, on the presence or otherwise of water, on the supply of metal for repairing roads, and, if we may trust somewhat similar appearances on the Gold Coast, at Hong Kong, and in the Seychelles, on the healthiness or unhealthiness of the climate. It is scarcely necessary to remind you that though mountain ranges and rivers materially affect the operations of war, they are by no means insurmountable obstacles. The Alps have been repeatedly crossed since the days of Hannibal; Wellington crossed the Pyrenees in spite of the opposition of Soult; Diebitsch the Balkan, though defended by the Turks; and Pollock forced his way through the dreaded Khyber; whilst there is hardly a river in the length and breadth of Europe that has not been crossed, even when the passage has been ably disputed. This is hardly the place to discuss the minuter details of military geography and topography: they will be found in the works specially devoted to the subject.

Queen Elizabeth's Minister was right when he said that "knowledge is power"; and a knowledge of the physical features of a country, combined with a just appreciation of their influence on military operations is a very great power in war. A commander entering upon a campaign without such knowledge may be likened to a man groping in darkness; with it he may act with a boldness and decision that will often ensure success. It was this class of knowledge, possessed in the highest degree by all great commanders, that enabled Jomini to foretell the collision of the French and Prussian armies at Jena in 1807, and in later years enabled a Prussian officer, when told that MacMahon had marched northwards from Chalons, to point unerringly to Sedan as the place where the decisive battle would be fought. As, then, all military operations must be based on a knowledge of the country in which they are to be carried on, it should never be forgotton that every country contiguous to our own—and the ocean brings us into contact with almost every country in the world—may be a possible theatre of war, and that it is equally the duty and policy of a good government to obtain all possible information respecting it. Is it with much satisfaction that we can turn to the efforts made by this country to acquire that geographical knowledge which may be of so much importance in time of need? Though we had for years military establishments on the Gold Coast, and though we had, more than once, been engaged in hostilities with the Ashantis, and might reasonably have expected to be so again, no attempt appears to have been made to obtain information about the country north of the Prah, or even of the so-called protected territories. The result was that when the recent expedition was organized, the Government had to depend chiefly on the works of Bowdich, Dupuis, and Hutton, written some fifty years ago, and on a rough itinerary of the route afterwards followed by the troops, for their information relating to the country and its inhabitants. What advantage has been taken of the presence of the officers who have been in Persia during the last ten years to increase our knowledge of that country—knowledge which would be very useful at present in the unsettled state of the boundary questions of the Northern and North-Eastern frontiers? How little has been added to our knowledge of Afghanistan since the war of 1842? and what part did India take in Trans-Himalayan exploration before Messrs. Shaw and Hayward led the way to Yarkand and Kashgar? It was with feelings of no slight satisfaction that many of us heard last year that the policy of isolation and seclusion which India appears to have adopted as the last soldier of Pollock's relieving force re-crossed the Indus was at last to be broken, and that an expedition, well found in every respect, was to be sent to Kashgar. It seemed an awakening from the long slumber of the last thirty years, during which we were content to stay at home in inglorious ease, resting under the shadow of the great mountain ranges of Northern India, whilst we sent out mirzas and pundits to gather the rich store of laurels that hung almost within our grasp.

Far be it from me to depreciate the valuable services of those gentlemen—services frequently performed at great personal risk and discomfort; but who can compare the results they obtained with those that would have been brought back by English officers, or by travellers, such as Mr. Shaw, Mr. Ney Elias, and others. It has been said that if officers travelled in countries where Government could no longer protect them, they might be killed by the natives, and that then, if the murderers were not punished, England would suffer loss of prestige. But is this the case? As a matter of fact, the number of travellers who lose their lives at the hands of the natives of the countries in which they are travelling is quite insignificant when compared with the number of those who return in safety. Let us, then, hope that the Kashgar mission may date the commencement of a new era, during which geographical enterprise may be encouraged, or at any rate not discouraged amongst the officers of the army, and that, if few will now deny that a knowledge of Ashanti, of Yemen, of the Northern and North-Eastern frontiers of Persia, of Merv, Andkin, Maimana, Badakshan and Wakhan, would have been of importance in the years just passed, it may not be forgotten that a knowledge of these countries may be of still more importance in a not far distant future. May we not take a hint in this respect from our now near neighbours in Central Asia, the Russians? No one who has followed their movements can fail to have been struck by the intense activity of their topographical staff, an activity that can only be compared to that of England at the period when Burnes, Eldred Pottinger, Wood, Abbott, Connolly, and others, whose names are ever fresh in our memories, were penetrating into the wildest recesses of Central Asia. In alluding to the contributions of war to geographical science, it is perhaps hardly necessary to mention the very obvious manner in which military operations teach us geography by directing our attention for the time being to the country in which they are being carried on, or to the direct results that have followed many campaigns from the days of Alexander to our own. The Russians are indeed far in advance of us in all that relates to those survey operations, and that geographical exploration which should always be carried on simultaneously with the advance of an expeditionary force into an unknown or but partially known country; they have long since realised the importance, almost necessity, of accurate geographical knowledge, based on sound systematic survey, and having learned in time the lesson that opportunities once lost may never be recovered, make every effort to take advantage of those that are offered to them. In the expedition against Khiva each column had attached to it an astronomer and small topographical staff, whose duty it was to fix the geographical positions of all camps, and map the route and adjacent country, whilst officers on detached duty were instructed to keep itineraries of their routes which might be fitted into the more accurate survey. On the fall of Khiva an examination of the Khanate was at once commenced; and it was even thought necessary to send Colonel Skobelof, disguised as a Turkman, to survey the route by which Colonel Markosof should have reached the asis. It is much to be regretted in the interests of geography that some such system was not adopted during the recent operations on the Gold Coast, and that so little, comparatively speaking, has been added to our knowledge of Ashanti and the protectorate. The conclusion of peace with King Coffee, and the effect that must have been produced on the inland tribes by the destruction of Kumasi, appear to offer facilities for the examination of a new and interesting region which it is to be hoped will not be neglected by those who are able and willing to take part in the arduous task of African exploration.

The most important military contributions to geography have undoubtedly been those great topographical surveys which are either completed or in progress in every country in Europe except Spain, Turkey, and Greece. Frederick the Great was, I believe, the first to recognise that in planning or conducting operations on a large scale, as well as directing many movements on the field of battle, a commander should have before him a detailed delineation of the ground of a whole or part of the theatre of war. To supply this want, Frederick originated military topography, which, in its narrower sense, may be defined as the art of representing ground on a large scale in aid of military operations. It was found, however, that during war there was rarely sufficient time to construct maps giving the requisite information, and thus the necessity arose of collecting in peace such data as would enable maps to be prepared. In this necessity may be seen the origin of all national topographical surveys, including our own, which was commenced as a purely military survey in 1784 by General Roy, and transferred in 1791 to the old Board of Ordnance. The gradual development of these surveys, and the various stages through which they have passed before reaching their present state of excellence, need not be noticed here. Side by side with the large establishments engaged in the production of the topographical maps, there have grown up in most countries extensive departments, sometimes employing from fifty to sixty officers, whose duty it is to supplement the maps of their own and foreign countries by the collection of all information of whatever nature that may be useful in time of war. The brief interval that elapses between the declaration of war and the commencement of hostilities, the rapid movements of armies and the short duration of campaigns at the present have shown more clearly than ever the imperative necessity of previous preparation for war; and the publication of the great surveys of most European countries has given an impetus heretofore unknown to the studies I have alluded to.

The progress of the European surveys, and especially of our own, has been marked by many results which have indirectly influenced the advancement of geographical science. Such are the improvements in instruments made during the progress of the triangulation, the introduction of the Drummond light, Colby's compensating bars, &c.; the connection of the English and Continental systems of triangulation; the pendulum observations at various places; the measurement of arcs of the meridian; the comparison of the standards of length of foreign countries, of India, Australia, and the Cape of Good Hope, with our standard yard, which has recently been completed at the Ordnance Survey Office, Southampton. In the same category may be placed the improvements in the art of map engraving, in the application of chromolithography to the production of maps as exemplified in the Dutch process of Col. Bessier and the Belgian maps; and the employment of electrotyping to obtain duplicates of the original plates. The method of copying maps by photography without any error in scale, or any distortion that can be detected by the most rigid examination, was first proved to be practicable, and was adopted in the Ordnance Survey Department, in 1854, by Major-General Sir Henry James, for the purpose of facilitating the publication of the Government maps of the United Kingdom on the various scales. Since that date the necessity of rapidly producing, multiplying, enlarging, and reducing maps has tended towards the development of the various photographic processes which have been brought to such a high state of perfection. During the last five years photographic negatives on glass covering an area of 10,071 square feet were produced at the Ordnance Survey Office for map-making purposes alone, and from these negatives 21,760 square feet of silver prints were prepared and used in the various stages of the Survey. An area of 959 square feet of the negatives was also used in producing 13,595 maps on various scales by the photo-zincographic process, which was also introduced by Major-General Sir Henry James. It was by similar processes that the Germans were enabled to provide the enormous number of copies of the various sheets of the map of

France required during the war of 1870-71. Any comparison of the maps of various countries would necessarily occupy much time, so I will only add that as specimens of engraving the sheets of our one-inch map are unrivalled, and that no foreign maps can compare for accuracy of detail and beauty of execution with the sheets of our six-inch survey. Our great national survey is the most mathematically accurate in Europe, and it speaks much for the ability of the officers who have brought it to its present state of perfection, that from the very first they recognised the necessity of extreme scientific accuracy in their work, and that they have never had to withdraw from the position they have taken up with regard to the many questions of detail that have arisen from time to time.

Before concluding this portion of my address I would draw your attention to the appliances used in the minor schools of this country for teaching geography, as they would seem to need some improvement. The appliances to which I allude are models or relief maps, wall maps, atlases, and globes. The use of models as a means of conveying geographical instruction has been too much neglected in our schools. If any one considers the difficulty a pupil has in understanding the drawing of a steam engine, and the ease with which he grasps the meaning of the working model, and how from studying the model and comparing it with the drawing he gradually learns to comprehend the latter; he will see that a model of ground may be used in a similar manner to teach the reading of a map of the same area. Relief maps of large areas on a small scale have their uses, but they are unsuitable for educational purposes on account of the manner in which heights must be exaggerated to make them appear at all; this objection, however, does not apply to models of limited areas on a sufficient scale, which always give a truthful and effective representation of the ground. One reason why models have not been more used has been their cost, but the means of constructing them with ease, rapidity, and at slight expense, are quickly accumulating as the six-inch contoured sheets of the Ordnance Survey are published. Instruction in geography should begin at home, and I would suggest that as the six-inch survey progresses each decent school throughout the country should be provided with a model and map of the district in which it is situated. If this were done the pupils would soon learn to read the model, and having once succeeded in doing this, it would not be long before they were able to understand the conventional manner in which topographical features are represented on a plane surface, and acquire the power of reading not only the map of their own neighbourhood, but any map which was placed before them. In our wall maps I think we have been too much inclined to pay attention to the boundaries of countries, and to neglect the general features of the ground. It is difficult to say whether the maps have followed the teachers or the teachers the maps, but I fear instruction in physical geography too often comes after that in political geography, instead of a knowledge of the latter being based on a knowledge of the physical features of the earth. My meaning may perhaps be explained by reference to a wall-map, probably well known to every one, that of Palestine, which frequently disfigures rather than ornaments the walls of our schoolrooms. In this map there are usually deep shades of red, yellow, and green, to distinguish the districts of Judea, Samaria, and Galilee, and perhaps another colour for the Trans-Jordanic region with a number of Bible names inserted on the surface, whilst the natural features are quite subordinate, and sometimes not even indicated. There is perhaps no book that bears the impress of the country in which it was written so strongly as the Bible; but it is quite impossible for a teacher to enable his pupils to realise what that country is with the maps at present at his disposal. The first object of a wall-map should be to show the geographical features of countries, not their boundaries, and for this purpose details should be omitted, and the grander features have special attention paid to them. In school atlases the same fault may be traced, physical features being too often made subordinate to political divisions; and there is also in many cases a tendency to overcrowd the maps with a multitude of names which only serve to confuse the pupil and divert his attention from the main points. The use of globes in our schools should be encouraged as much as possible, as there are many physical phenomena which cannot well be explained without them, and they offer far better means of conveying a knowledge of the relative positions of the various countries, seas, &c., than any maps. The great expense of globes has hitherto prevented their very general use, but some experiments are at present being made with a view to lessening the cost of their construction, which it is hoped may be successful. I cannot pass from this subject without alluding to that class of maps which gives life to the large volumes of statistics which are accumulating with such rapidity. On the continent these maps are employed to an extent unknown in this country, both for purposes of reference and education, and they convey their information in a simple and effective manner.

The PRESIDENT then noticed briefly the most important geographical events of the year, and concluded his Address by enumerating the papers to be read during the meeting.

ARCTIC EXPLORATION.

Mr. E. C. RYE read a paper by Admiral Sherard Osborn, C.B., F.R.S., on the "Routes to the North Polar Region," which forms the leading article of our present number.

Lieutenant HERBERT CHERMSIDE next read a paper on "Mr. Leigh Smith's voyage to Spitzbergen."

In this communication a narrative was given of a series of three explorations made by Mr. Smith in his yacht 'Sampson,' in the years 1871, 1872, and 1873. On the last of these occasions the author accompanied Mr. Smith. The various voyages were undertaken between May and September, and were minutely traced by Lieutenant Chermside, the furthest point reached being considerably to the north of the Seven Islands. He described the difficulties experienced from ice floes and foul ground encountered inshore; he also referred to the fortunate relief which Mr. Smith was able to afford the Swedish Arctic Expedition in 1873, who had been frozen in from the previous year. A description of the physical geography of Spitzbergen terminated his paper.

Admiral OMMANNEY remarked that he believed the late Government fully intended that an expedition should be sent out, but the change of Ministry altered the aspect of affairs, and now a declaration of policy in reference to this and other points must be waited for. It was to be hoped, however, Mr. Disraeli would follow up what was believed to be the intention of Mr. Goschen on the subject.

Captain S. ANDERSON, R.E., then read a paper "On the Demarcation of the International Boundary between Canada and the United States," which we purpose publishing in our next number.

Friday, August 21st.

AFRICA.

THE first paper read was one by Mr. E. G. RAVENSTEIN, F.R.G.S., F.S.S., "On Dr. G. NACHTIGALL'S Explorations in Africa, 1869-74." Dr. Nachtigall's important explorations in Eastern Sahara and in Sudan are but little known in England, we shall therefore publish this paper *in extenso* in our next number.

Surgeon-Major S. ROWE, C.M.G., read a paper "On Sir J. Glover's Expedition from the Volta to Kumassi."

The author gave a description of the position and political relations of the tribes in the eastern division of the Gold Coast territory intended to be raised and trained by the Glover Expedition; also of the Trans-Volta tribes, and a short attack of the Ashantis on Krepi in 1869, and the capture of the German missionaries. He referred to the treaties made in 1869 by

British authorities with the Aquamus and to the successful attack on the piratical island of Duffo in 1870; and then described the confidence of the Haussas and Yorubas in Captain Glover, and their arrival from Lagos to join him; the assembly of the Beach tribes at the mouth of the Volta at Addah Fort, and of the Aquapims, Krobbos and Krepis at Blappáh under Captain Sartorius, the crossing of the Volta (23-25 December), and the successful fights at Farah and Adidumay. He then alluded to the causes of Captain Glover's return over the Volta, and described the incidents of the march through Krobbo, Aquapim, and Akim to Ashanti, with the crossing the Prah on 15th January, and the taking of Abogu, Bangsu, Towassy, Connummo, and Odumassi, and the different attempts made to communicate with the main body under Sir Garnet Wolseley—amongst them, the passage of the Anum River by Sartorius. The presence of Sir Garnet's force in Kumassi was communicated by two fugitive slaves from Bankra. After breaking all communication with their rear, the column marched forward, arriving at Essianimpon, where Sartorius set off to open communication with the main body. The author then described the arrival of the Glover column in Kumassi, the appearance of that town, and the dissatisfaction of the native contingent at leaving it so hurriedly. He sketched the return march to the coast, and summed up the assistance rendered, in his opinion, to the main body by the operations of the contingent. The languages of the native allies, the products of their country, their style of living, and the supply of gold were briefly mentioned.

Mr. BALL, after remarking that no one could fail to be satisfied with the great importance of Sir John Glover's Expedition, adverted to the question of the duty of this country with reference to these African tribes. It was his opinion that a great country coming in contact with an uncivilized people had forced upon it duties from which it must not shrink if it would avoid the condemnation of posterity.

Extracts from a letter which had been received that evening from Colonel Gordon, who wrote from the River Lobat on the 26th of June, were then read by the President. The communication showed that the writer was taking energetic steps to put an end to the slave trade in that region.

Extracts were also read from the journal of Lieutenant Cameron, with reference to the East African Expedition.

Dr. SCHWEINFURTH'S paper, "On the Oases of the Lybian Desert" was then read by Mr. THOMAS, one of the Secretaries.

In undertaking, at the flattering call of the President of the Geographical Section, to present a report to this distinguished assembly of the results of my last journey to the Lybian Desert, my principal object is to testify to the high interest which, in more than one respect, belongs to this part of Africa, hitherto so much neglected by science.

The Lybian Desert, comprising, as it does, one-third of the Sahara, is represented by one of those three white spots, which appear on our maps of Africa, and which present the problem which has yet to be solved of this mysterious part of the world.

Up to the present time, the knowledge we have possessed of the peripherical parts of these immense areas has been very meagre, and, strictly speaking, the well-known oases of Augila and Siwa, as also the chain of the large and small oases in the east, have formed, for the last half century, the limits of these large gaps in our geography. It is only lately that the districts of Tibesti and Runga, on the western margin, have been added by Nachtigall, and, the same distinguished traveller promises to throw great light upon the southern border—Wadai and Darfur. Last winter a great portion of the eastern border of the white spots I have just mentioned has been added to our knowledge of descriptive geography, and naturalists for the first time explored this region from every aspect.

The expedition for the exploration of the Lybian Desert, conducted by Gerhard Rohlfs, who was accompanied by three of the most distinguished learned men of Germany, will not only present us with a more thorough and exact topographical and hypsometrical picture of the configuration of this waste region, founded on careful measurement, but will also reveal to us its geology, zoology, and botany, whilst the photographs of the temple inscriptions will form a mine of historical reference for the antiquarian. In time numerous publications will inform us of the brilliant results of this undertaking, which will form an epoch in the strictly scientific exploration of Africa.

Encouraged by the example of the bold attempts made to cross the deserts of Australia, which were made in spite of the want of water and of competent guides, I resolved to contribute my mite towards a more thorough knowledge, especially as regards natural history, of the deserts of Lybia.

Without taking any direct part in the expedition undertaken by Rohlfs,* through the generosity of the enlightened ruler of Egypt, but looking at the common object to be pursued, along with the natural philosophers engaged in it, the portion of the extensive district to be explored which I had selected for myself was indeed very small in comparison with theirs. However, the narrow limits of my field of operations the better enabled me to penetrate into every local detail calculated to throw a gleam of light over this *terra incognita*. "Plus habet hic viae, plus habet ille vitae," says Claudian, and this saying reconciled me to the circumstance of my tour of this year only having been extended over certain latitudes and longitudes.

The great oasis called el-Khargeh (the outer) was the field of operations offered to me during the first four months of this year, whilst the oasis, Dakhel, the basis of Rohlfs's expedition, three days' journey westward, is called by the Arabs the inner one to distinguish it from the former. For the last forty years these oases have not been visited by any traveller of scientific attainments; even the stream of tourists which pours over Egypt every winter has left them untouched. From this it will be abundantly evident how much of what is new and unexpected is presented by them to the natural philosopher.

I left the town of Siut in the beginning of January, and after a march of five and a half days, having traversed 190 kilometres in an almost southerly direction, I reached the little town of el-Khargeh, the capital of the great oasis. At the end of April, after having made myself thoroughly acquainted with every part of it, 120 kilometres in length, I entered upon my journey back, by way of Girgeh, and after a forced march of two days and a half, during which I travelled 130 kilometres in the direction of E.N.E., I again found myself on the shores of the Nile. The cartographical result of my exploration of the great oasis was a triangulation founded on a measured basis of 3¼ kilometres.

In what follows I shall first of all describe its outward condition. The great oasis is bounded in its whole length towards the east by a line of cliffs, running in an almost straight line from north to south, and towering nearly 1000 feet above the bottom of the oasis itself, which is 300 feet above the level of the sea. These cliffs bound the table-land that separates the oasis from the valley of the Nile. The plateau rises on the opposite side conformably to the strata that compose it, so gradually that it only reaches the height of the eastern border of the oasis at a great distance. Thus the great oasis resembles the bottom of a gigantic valley, the width of which appears very much to exceed that of the Nile in its broadest part. It is bounded only in its extreme northern part by the sides of imposing rocks, which in the form of steep mountain chains have detached themselves from the mass of the Lybian plateau, whilst in a similar manner, projecting narrow-ridged mountains are

* The part of the district surveyed by Rohlfs's Expedition comprehends seventeen square degrees.

also peculiar to the eastern decline, which, however, seen from a distance, present the appearance of a continuous wall. The picturesque forms of rocks thus torn asunder are in their upper parts composed of the same hard, glittering reddish, nummulite limestone which covers the greater part of the Lybian plateau; in their lower parts these mountain sides consist of chalk banks, frequently of the most dazzling whiteness, the latter of which like shining battlements or bastions are spread over the entire length of the mountain. Such is the frame to the singular picture formed by this landscape which presents itself to the eyes of the traveller, in a manner so entirely different from the usual appearance of the valley of the Nile, as soon as he has reached the Katabathmos which leads down to the great oasis of Thebes.

We must not regard the great oasis itself as an uninterrupted verdant plain; nothing would be more erroneous than this idea. From the top of the eastern precipice, nothing presents itself to the eye of the spectator but the same monotonous yellow, which, as soon as we have left the corn-fields at the Nile, is the constant companion of the traveller, a monotonous alternation of high sand-dunes and desolate plains of gravel or sandstone, with black spots here and there, and dark green patches. These are the arable portions of the desert: the springs surrounded by tall acacias, and the neighbouring fields, palm-groves, brooks, and ponds enclosed with reeds. Little islands in the sandy desert are the oases within the oasis, and they realise the great picture of the entire desert, which, as Strabo says, may be likened to the skin of a leopard, which represents them in miniature.

The impression which the traveller receives as soon as he has put his foot upon the cultivated soil of the oases is altogether different. Here he is struck with the imperishable creation of the vivifying element, bubbling up as it were from the innermost depths of the earth; smiling, verdant plains, and shady palm-forests, the equal of which we seek for in vain amongst those on the Nile. He sees murmuring brooks and rivulets gliding their speedy course along—here so guided by human hands that in their passage they often cross and recross each other at different levels, there expanded to ponds and morasses; but all having their source in springs overshadowed by towering trees, and separated by newly-sprouting turf banks from the still greener fields. The rural charm of these cultivated spots is still more heightened by the singular aspect of the plains of magnificent green, which, now rising and falling in graceful waves, and again ascending terrace-like to the overflowing springs, offers itself to the eye that has been accustomed to the uniform level of the valley of the Nile. In contrast to the wilderness over which we have passed, this affords a picture of the most enchanting freshness and vigour; here, an active mass of plant and animal life is crowded into the narrowest space—there, the direct contrary is visible over the entire continent of Africa.

The number of the inhabitants of the great oasis is stated to be 5700 souls, which are very unequally scattered over the ten places that are inhabited. Of these, Khargeh alone counts 3000, whilst Beris, the southern town, has only 1000 inhabitants. The continual dread of being surprised by Tripolitanian hordes, compels them, armed though they be with firelocks, to confine their habitations to certain secure positions. The little town of Khargeh, for this reason, presents a fortification of a very peculiar kind. The houses are not built in and near the streets, but over them. The inner part of the town, therefore, called Ndällema, which signifies *darkness*, contains streets, which in every respect resemble a place where the houses are built on piles, supported by rough beams, in which the inhabitants are only able to grope their way in a stooping posture.

The inhabitants, although their language differs very little from that of the Egyptians of the present day, are evidently of very mixed descent, and in the type of their physiognomy betray no Egyptian characteristics. Their thin lips, long, narrow noses, and a slanting cut of the eyelids, distinguish in the clearest manner the expression of their countenance from the sharply defined type of the tribe of Pharaoh. In the inhabitants of Khargeh we look upon the remains of one of those numerous Lybian races which are numbered in the list of hieroglyphical nations, and which at all events belonged to the Berber race, to the same Lybians, who exhibited by numerous feuds a hostile resistance to the inhabitants of the valley of the Nile, and whose civilization, to judge from the plants cultivated, as well as from history, has not, like that of the Egyptians, proceeded from south to north, but from the north, that is to say, from the Mediterranean Sea.

The inhabitants of the oases are distinguished from the Egyptians by a signally yellow complexion. It is a common saying in Siut and Girgeh—the people of the oases are pale and yellow, for they always suffer from fever. In fact, intermittent fevers, especially during the hot season, are the order of the day, for then the air is impregnated with miasmatic exhalations, arising from the culture of rice. In their customs, likewise (I allude only to the people of Khargeh), they differ considerably not only from the Egyptians, but also from the Bedouins, who have settled on the western border of the valley of the Nile. Situated on the great caravan high roads of Darfur, a great many of the customs of the Sudan have become naturalised in Khargeh, whilst now and then even heathen reminiscences of antiquity are to be met with. The people of Khargeh are generally very tolerant, and at the same time exceedingly lax Muhammadans; have a small perception of the difference between clean and unclean; hold the prescribed prayers in contempt, and scoff and jeer in married life, with a freedom unheard of, at all the laws of the prophet. With exception of smallpox, partly held in check by compulsory vaccination, contagious diseases are unknown in the oases. Coptic Christians, however comparatively recent may have been their conversion to Islamism, have disappeared from amongst the population, and not a single tradition has been handed down from the Christian era.

Nevertheless, so much plainer are the testimonies of the past, which proclaim the former prosperity of the oases. Five large temples, the origin of which reaches to the fifth century before Christ, point to the ancient relations to the valley of the Nile, which, according to inscriptions on Egyptian temples, refer us back to the 15th century; whilst seven strong Roman castles, of the time of the early emperors, reveal the important part which this now desolate province once played in the Roman empire. Hundreds of wells, now filled with sand; the grand Necropolis of Hibe; the capital; the for the most part well preserved remains of numerous dwelling-houses, and dovecots, ruins of convents, and chapels, distributed over the entire oasis, even to its most desolate parts, all testify to the largeness of the former population, and to the immense extent of its cultivated portion.

With exception of the old Egyptian temples, all the above-named buildings are constructed with unburnt bricks, and, in consequence of the scarcity of rain in this quarter, are in a state of great preservation. The subsequent depopulation of the country has contributed to their preservation.

The large Roman castles, of which there are none to be found in the Nile Valley, are deserving of the greatest interest. Four of the largest are built over and around the ancient temples, whose fore-courts, subsequently renovated, bear well-preserved Grecian inscriptions, which give the date of their construction. We find there the names of Titus, Galba, and Trajan, as well as those of the respective Eparchs, and army commanders; also those of the three principal towns, Hibe, Kysis, and Tchonemyris, the sites of which can be established with the greatest certainty. The

area of the castles is from 50 to 60 metres square, and the surrounding walls are 15 metres high, and from 3 to 4 metres thick. The large bricks are joined together in such a way that in each layer the horizontal line of the bricks deviates by 60 degrees from that of the superincumbent layer, so that everywhere three differently joined layers are visible. The surrounding walls are generally double, and held together by arches, whilst the intermediate space is occupied by the stairs leading to the battlements. Moreover, massive round towers add to the solidity of the masonry. Inside the wall the temple is surrounded by a number of small arched spaces, irregularly traversed by passages and corridors. Here were the quarters of the garrison, which, according to a historical notice, included two squadrons of Germanic cavalry. Close to the castle of Dush is still to be seen the dwelling of a commander in the time of Trajan, in excellent preservation, consisting of several high arched saloons.

The ancient inhabitants of the oases must have been accustomed to much greater comfort in their habitations than that enjoyed by the present generation, whose low huts, built of mud and palm branches, appear to be constructed in the rudest manner. By the use of arches they were enabled to dispense with wood, whilst at the same time they were able to give a noble form to their buildings. The most signal example of this is to be found in the great Christian necropolis of Hibe, in the vicinity of Khargeh, whose preservation has remained so perfect, that in perambulating its long streets it is only the portions of mummies which lie scattered about, and the large heaps of grave clothes which are brought to light by Muhammadan desecraters of graves in digging after hidden treasure, which give us the impression as if we were still living in the first centuries of Christianity.

This necropolis commences at the foot of the Gebel el Ter, and consists of more than two hundred small and larger mausoleums, covering a slope extending towards the south. Ornamented with cupolas and pillars with niches and entablatures, these mortuary constructions betray more harmony with Roman than with Greek architecture, and deviate in the strangest manner from everything which Egypt has to offer in this respect. At the same time, this Christian necropolis furnishes the most interesting proof that embalming was certainly practised here by the Christians of the first five centuries.

There are few places in the world which can furnish to the spectator a more eloquent picture of the slowness with which time works in the transformation of surfaces, such as the desert valleys of Lybia, where a thousand years appear to have passed away as if they were only a day. This fact impressed me deeply, as I once suddenly found myself in a distant part of the valley of Gebel el Ter, opposite the side of a high wall of chalk, covered with inscriptions dating through a series of centuries. Here a certain Herakleos relates, in plainly written Grecian letters, that on this spot he had sacrificed hens, doves, and other objects; there, at the end of a demotic inscription, we find the date of the reign of one of the Ptolemys, or a contemporary of Charles the Great has scrawled over it in cufic characters, or the eye lights upon an "Eleison me," written in red, an "Apakire" (holy father) of the time of Constantine scratched into the stone; and yet the thin sheet of chalk on which the red characters are written has not yet been able completely to detach itself from the rocky mass. From this we may be able to comprehend the immensity of time it must have taken to smooth the sides of the rocks. Of all the impressions which force themselves upon the travelling natural philosopher in Africa, there is none more enduring than that which he receives from the age of the present condition of this continent.

The present cultivation of the great oasis is founded on the existence of seventy-five active springs. They have all their origin in the earliest antiquity, and empty themselves through pits artificially hewn out, from 60 to 100 metres deep, and one metre in diameter. The most ancient hieroglyphical texts make mention of this system of irrigation. The present inhabitants have no idea of opening new springs, but employ all their sagacity in utilising those already existing, filled as they are with sand. There is in the desert a particular order of divers, who for the small sum of 100 copper piastres (equal to 4 shillings) per ell, at the imminent risk of their lives, will undertake to clean out the wells. By means of heavy iron pipes attached to long cables, which are drawn up and down, the inhabitants are able in many cases to cause a spring to force its way through the sand, without having recourse to these divers.

In the Dakhel oasis borings have been made within the last few years, by an Egyptian engineer, which hitherto have, in every case, been attended with the best results. At a depth of from 60 to 100 metres, water is found everywhere in the oases, and in every place the stock of subterranean water appears inexhaustible. If more attention were paid to the boring of Artesian wells, it would be easy to restore these provinces to their former prosperity.

Whence arises this inexhaustible provision of water, in the depths of the earth? This question has already been attempted to be answered in various ways, but no explanation has been given in harmony with the geological condition of the Lybian desert. It was formerly thought that they were situated at a good distance beneath the level of the Nile Valley, and received their water from that river, by infiltration through the lower strata; it was believed also that this connection might be proved by the periodicity of the wells. All these theories have proved to be erroneous. The height of the oasis in relation to the sea is nearly the same as that of the Nile in the same latitude. A subterranean fall of the Nile waters to the west is rendered impossible by the rise of the strata in this direction; the supposed periodicity could not be recognized by any of us.

There is a greater probability in the hypothesis according to which the water of the oasis has its source in the Nubian Nile, probably above the cataracts of Wady Halfa. The greater height above the sea at this part of the Nile, and the geological features of its valley would support this hypothesis, and to the facts above stated must also be added the geographical arrangement of the valleys of the oases which shows a chain running tolerably parallel to the Nile Valley, which beginning with the oasis called Kaeb, ten hours west from Dongola, appears to be connected with the oasis of Khargeh and Dakhel, by means of those of Selimeh, Kurkur, and Shebb.

The supposition that the waters of the oases originate in the waters of the Tsad Lake, now disappearing in such an inexplicable manner, is scarcely to be accepted. As is well known, this great lake, apart from the Seistan Lake and the Tanganyika, is the only sweet inland water for which, so far, it has not been shown that there is any outlet. Nachtigall, in his journey to Runga, gained the information that the waters of the Tsad extend periodically in a north-east direction, extraordinarily far into the Sahara. The geological features of the latter are in perfect harmony with this hypothesis. One circumstance, however, which, in my opinion, appears to refute all these theories, must be considered in reference to the springs in the oases. All these springs, wherever they rise up directly from the earth, are thermal; and their temperature, varying from 25° to 30° Celsius, exceeds by far the average temperature of the year, of the districts in question, consequently it must also exceed that of the upper strata of the Sahara.

Another question, which appears to be closely connected with those we have just touched upon, is this:—Are there from the Egyptian Nile Valley westward visible traces of the bed of a former current, through which the Nile might have flowed? By our last explorations in the Lybian Desert this question has been unanimously negatived. On all our maps of Africa hitherto there

has figured an imaginary system of oasis valleys, which as Bahr-bela ma—that is, river without water—used to be connected with it. Nevertheless, Bahr-bela ma is in desert countries a frequently recurring local designation for valleys and sand-wadys, which in some places reminds one of the dried-up bed of a river. Even the Lybian Desert has places of that kind to show; nevertheless, a continuous fall in a valley to the north exists nowhere, except that of the oasis chain already pointed out. The plateau between the great oasis and the valley of the Nile offers neither valleys nor hills which tower even to the height of 100 feet above the adjoining plains; in fact, on tracts which it takes hours to travel over, the land is so wanting in every topographical dissimilarity that we should be obliged to sketch stones if we were to attempt to fill up the maps of these places with details of any kind.

The conclusion that the Nile in times past has taken its course through the chains of the oases is contradicted by the condition of the soil of the oases themselves, which presents only the uncovered strata of the middle chalk formation, and betrays no traces anywhere of the clayey alluvial land of the Nile. There is no fish in any of the waters of the great oases, nor in that of Dakhel; it is only in the ponds of Siwa that a species of *Cyprinodon* exists. The botanico-geographical facts which we shall have to consider shortly also contradict most decidedly the above-mentioned hypothesis. A short survey of the geological relations of the Lybian Desert might be of service for the further ventilation of the subject of springs and rivers. According to Zittel's explorations the formations which present themselves to our views in this region are the diluvium, the miocene, the eocene, the upper and middle chalk.

Diluvial formations are met with only in one spot, between Khargeh and Esneh, represented by a travertine, which betrayed, by its impressions of leaves and grass, the entirely changed nature of the present Lybia. Nummulite lime and white chalk play the principal part in the composition of the Lybian plateau. The strata strike usually from south-west to north-east, and incline gently towards the Nile Valley, so that the further the traveller penetrates into the desert, towards the west, the older are the strata which he has to expect. It is only in the north of the district that an exception to this rule is visible, for there the nummulite formation sinks gradually towards the west, to serve as the bases of powerful miocene formations, which rise up in mountains around the oasis of Siwa, and are connected with the Cyrenaika.

Amongst the eocene formations, a hard silicious limestone, belonging to the lower nummulite formation attains in the greatest development, and forms the surface of the largest part of the tract of the desert, situated between the oases and the Nile. The road often leads for hours over these cliffs, which are sometimes dazzling white, and at other times brilliantly red; and they sometimes offer to the view the most deceptive aspect of endless glaciers. Under this hard lime, characterised by alveolites, there lie soft marly layers containing lucinæ and operculinæ, of the latter of which entire strata are to be found.

Immediately under the operculinæ strata, we often see everywhere on the sides of the rocks of the oases a snow-white limestone, which, by the broad walls and projections it forms, gives to the landscape such a picturesque appearance. This is the representative of the white chalk of the north of Europe; but it abounds much more in petrifactions than anywhere with us, and most resembles the chalk of the Paris basin.

Under the cretaceous limestone begins an agglomeration of very laminated marls interrupted by banks of clay and lime. These marls, which in their upper parts are green and grey, attain great thickness; they contrast distinctly from the superincumbent white walls of the chalk. Underneath, the marls become dark brown and brick red. The latter exhibit an agreeable red colour, and from time immemorial have been exported from the oases to the Nile. The hieroglyphical texts give to these red earths the name of *mensh*. The above-mentioned inscriptions at Gebel-el-Ter and in the necropolis are all written with this ruddle. In the Egypt of the present day the red earths are used for colouring walls.

The most surprising thing in the green and red marls is the mass of hydroxide of iron, of petrifactions, of pseudo-metamorphoses, nodules, nodes, and kidney-shaped objects, with which the ground seems strewn for miles.

Further down, and still alternating with green marls, there are extensive banks of argillaceous limestone, of a red and yellow colour, with millions of the *Exogyra Overwegii*, of which, having become disintegrated, whole hills are exclusively composed. Here also were found the interesting ammonites belonging to the group of the ceratites, and one entire fauna of these strata appears to consist of new and unknown kinds.

The marls under the exogyra strata contain the alum which, next to dates, forms the principal article of export.

In the continual alternation of marly and quartz sandstone, we perceive a gradual transition from the exogyra strata to the true sandstone which finally prevails on the ground of the oasis. This sandstone extends without interruption to the west and south of Dakhel and Khargeh as far as Sudan, and as it contains nothing but fossilized wood, we can only regard it as belonging to the middle cretaceous formation, and to the uppermost stratum of the highly developed Nubian sandstone formation.

The marls imbedded in the sandstone form the arable land of the oases, and the springs issue between them and the firm strata. Whence run these springs which flow here almost at the level of the sea? Do they discharge themselves deep under the coasts of the Mediterranean Sea, between Egypt and Cyrenaika, somewhat similar to the disappearing brooks in the north of Adria? That is a question which there, at some future time, perhaps, measurements which have still to be undertaken of the salinity of the sea at different depths, will furnish a solution.

The subterranean water of the oasis cannot be calculated, but we may safely assume that its volume is equal to that of a first-class river.

After becoming acquainted with the soil of the great oasis, let us turn our attention to the use which can be made of it by man. The irrigation of the fields is in a most primitive state. In the oases neither draw-wells nor wheels for lifting water are known. In the valley of the Nile they make the water, so to say, run up hill; here it is made to run naturally to any spot we like. In order to lift the water to any necessary height, we have only to surround the spring with a crater-like dam, which, as a rule, may be taken to any height, and which in general is from 40 to 50 feet. The principal difficulty of agriculture is the unequal distribution of arable soil, and the springs which may be available. Where excellent soil exists, there frequently the well is wanting, whilst at other times it is necessary to bring the water from a great distance, in order to avoid the salt deposits; for besides alum, there is common salt and Glauber's salt in whole beds, between the fertile marls of the Nubian sandstone. This is the reason why so much water is lost in the great oasis, and after becoming brackish it spreads over the lower plains, forming ponds and pools bordered by rushes, and filled up with Charae, which for their part have an injurious effect upon the climate.

In fact, these ponds of the great oasis contain only the surplus stock of the water used for irrigating the fields during the winter months. In summer, when the cultivation of rice requires all the available water, the ponds evaporate, and, as a natural consequence, fever and a plague of gnats follow.

Apart from the salt properties of the soil and the scarcity of water, there is another element of the desert which threatens destruction to cultivation. These are the moving sands, which, in the form of sand-hills, usurp the

finest part of the oasis, covering the fertile soil, and burying the palm groves. The small town of Khargeh is placed in a difficult position by this hostile element, and the sand-hills are advancing continually.

Nowhere do I recollect having seen similar masses of sand, which remind us forcibly of the snow plains in our own highlands, which they exactly resemble in their formation. Following the prevailing direction of the wind, all these sand-hills go from north to south, with a gentle inclination to the west, forming in this direction a steep crescent-shaped arc. The relative elevation of these sand-hills amounts here to from 30 to 100 metres.

On the north side of these sand-hills, beaming in the blazing sun, on a gradually inclining slope, the foot steps out firmly on the fine lamelliferous soil; on the steep southern declivity, however, it sinks into the loose mass of earth, which, like a snow-heap, ends in a sharp edge. From both sides sharp-edged notches, blown up by the wind, fall arch-like from one height to another, connecting the several sand-hills with each other. It need hardly be added that the sand-hills exclude all vegetation.

The largest sand-hills, however, begin only in the west of the oasis of Dakhel, where, insurmountable for camels, they prevented the advance of Rohlfs's expedition, and forced them to take a north-north-west route. Rohlfs himself, the only one who has travelled through the Sahara in every direction, confesses that in no other part has he ever seen sand-hills of such height and extent.

The cultivated plants of the great oasis are of greater variety than might be supposed, from the circumscribed limits of the arable soil. With exception of the hogs-bean, which in the Egyptian valley of the Nile is an object of extended culture, we find there every other kind of plant. The cereals which are grown are rice, wheat, barley, and the caffercorn. Maize, sesamum, and linseed are not cultivated in the great oasis; just as little are cotton, lupines, and safflower, which are only now and then found in gardens. Rice is only sown in the height of summer, and its cultivation is restricted to the northern half of the oasis. Wheat and barley are planted during the winter to the whole extent of the oasis. The harvest of these cereals is in the middle of April, about a fortnight later than in the neighbouring valley of the Nile. In the same way as the cultivation of rice is restricted to the north side of the oasis, that of the caffercorn (Durra) is limited to the south side. For the same reason the principal food of the inhabitants is, according to their abode, rice or caffercorn. Their stock of wheat is insufficient for their wants, and must be eked out by importations from the Nile. Barley is generally reserved for feeding domestic animals. Moreover, wheat in the oasis degenerates very easily; it is consequently necessary to obtain every other year fresh seed from the Nile. The small kind of degenerated grain is called "sihny." Barley is not influenced by the nature of the soil, but thrives well under any circumstances. The rice of the oases is of excellent quality, and deserves to be exported if the natives were enabled to grow it in larger quantities than is required for their own consumption.

As is well known, the most important branch of agriculture for the inhabitants of the oases, is the cultivation of the date tree, their wealth being estimated according to the number of trees which the one or the other possesses. Apart from the indigo, dates furnish alum and red chalk, this being their only article of export. The number of female trees in the great oasis is estimated at 80,000, but I believe the number to be under estimated, for reasons easily explained. The taxes are based on the number of palm trees, and the area of the cultivated soil. Moreover, the government also levies a tax on the baskets (Guffer) which are plaited out of the leaves. For every 100 palm trees, thirty baskets must be delivered at Siut, where resides the Mudir charged with the government of the oases.

Notwithstanding the spread of their roots, date trees also here require an artificial irrigation, the moist ground caused by the springs being inaccessible to them. The palm-groves are watered four times every month. It is seldom that the trees in the oases attain to a height of more than 30 feet, but their width and the leafy abundance of the tops, more especially the surprising length of the several leaves, testify to the luxuriance of their growth. The finest trees are found near the village of Bulak, six hours south of el-Khargeh, and it was here that I had the opportunity of meeting with the unheard-of existence of a date tree possessing six-fold ramifications of long, shooting branches. This tree, the like of which is probably not to be found in the world, is called "Nekhl-el Hadji Manzur," and is of the feminine gender, and about sixty years old. Each of the six tops furnishes a rich harvest every year. On other trees I observed a single formation of branches now and then at the side, only two instances of which I had observed in Egypt up to that time.

In the way of domestic animals, donkeys, cows, and buffaloes are reared in the great oasis. Sheep degenerate easily there, and have always to be replaced by those from the Nile Valley. In the great oasis there are about a dozen horses, which thrive well. On the other hand, it is absolutely impossible to acclimatize the camel, not one of which is to be found in the great oasis. It is not by reason of the scarcity of fodder, for there is no lack either of suitable pasture or of straw, clover, and green food, but they succumb, as I was told, to the damp, miasmatic air of the summer months, as well as to the plague of midges and flies.

The number of dogs and cats which we see about the dwellings are very limited. Of fowls, only pigeons, hens, and turkeys are kept.

The extraordinarily large number of mammals harboured by the great oasis, constituted one of the principal objects which I proposed to study. With the aid of various traps which I took with me I was able to catch a great number of specimens of these animals, preferring, as they do, a night life, and I filled several boxes with skins and skeletons.

Five species of beasts of prey are frequently met with in the great oases, the wolf-hound *(Canis lupaster)* the Lybian lynx *(Felis libyca)*, the Nile fox, the jackal, and the fennek *(Megalotis cerdo)*. Of the latter, the smallest representative of the wild dog genus, I brought ten living specimens to Europe, in good condition. The fennek is the most frequent of the five beasts of prey in the oasis, and is caught in snares by the natives in a simple and ingenious manner. They despise the flesh of no wild animal, provided it is killed according to rule. There appears to be no hyenas in the oasis, or, at all events, they are only to be met with individually on occasions of the passage of the great caravan of Darfur, when they are allured by the fallen camels. In the south of the oasis, the dog hyena *(Canis pictus)* is said to make its appearance now and then.

The large number of small gnawing animals *(Meriones* and *Dipus)*, which inhabit the desert in the vicinity of the cultivated ground, with whose holes the soil swarms, form the edacious conditions for such a vast number of robbers of the larger and smaller sort. They are continually grubbing in the ground for mice. The Lybian lynx, however, will frequently attack the grazing goats in broad daylight. The Nile fox and the fennek sneak into dovecots and fowlhouses, and thus prevent the natives from paying greater attention to the rearing of fowls. Locusts and lizards *(Acanthodactylus)* are devoured by the fennek with especial predilection, their great number making the conditions of his existence much easier. But it is the date especially which is the most welcome dish to the numerous beasts of prey, and in the furthermost valleys of the desert, the kernels which lie scattered about in every direction betray the track which they have taken.

The feathered tribe of the oasis is peculiarly circumstanced, on account of the small number of stationary

birds which it harbours in winter time, and the multitude of birds of passage which find a resting-place there in the spring and autumn. During the months of January and February I counted about a dozen of the first-named class, among which were two species which hitherto had been observed only in Arabia and Nubia. In the first part of April the greatest number of birds were to be seen, amongst which, singularly enough, I observed neither ducks nor geese, although the numerous waters of the desert would appear to invite a visit.

Before concluding, I will add a few words respecting the flora of the great oasis, the explanation of which was the principal reason which induced me to visit it. My observations and collections agree with those of Dr. Ascherson, who accompanied the Rohlf-expedition, in such a signal manner as to lead to the conclusion that all these oases in the east of the Lybian Desert have one and the same flora, which, in spite of the fewness of their species, nevertheless present an unexpected contrast to the vegetation of the Nile Valley on the one hand, and to that of the valleys of the desert on the other. What we obtained of the wild-growing kinds amounted to 225 species, and we do not believe that even a more thorough exploration would result in the increase of this number by more than a fourth.

After deciding upon the existing species, we arrived at the following botanico-geographical conclusion:—Nearly the half of all the species of plants we met with may be considered as being connected with the culture of rice. These, with few exceptions, point to India (for instance, a Lemna), are types of the Mediterranean flora, and are nearly all again met with in the environs of Alexandria, under similar conditions of existence, but are mostly totally absent in the entire valley of the Nile. We have, however, enriched our catalogue of the Nile flora with a number of species which hitherto were not to be found near Alexandria. One thing is especially remarkable about them, and that is the predominance of leguminous plants; which is explained by the quantity of Alexandrian clover, which has been introduced with the cultivation of rice, for in winter every rice-field is turned into a clover-field. In the southern half of the great oasis rice is not cultivated. The leguminous plants with which all the fields in the north are filled are also absent. The wheat and barley fields in the same district are almost free from weeds. In the south of the oasis we find generally a more uniform flora, bearing a greater similarity to that of the desert.

Very few plants of the black soil of the Nile reappear in the oases, which, as regards the flora, are as characteristic as are the sharply defined features of the inhabitants for the Egyptian race. The representatives of the flora of the Theban Desert, which we find on the Arabic side, on the borders of the cultivated district of the oasis, are, however, more numerous, but they do not remind us in the least of the variety which exists in the valleys between the Nile and the Red Sea.

What strikes us most is the scarcity in the oasis of those species of plants which undoubtedly belong to the borders of the tropics. Of this group I could only mention one shrub with certainty—the *Cordia subopposita D. C.*—of which, however, it is still doubtful whether it may not have been recently brought into the country by the Darfur caravan. Two others, the *Balanites*, and the *Calotropies*, may indeed be regarded as of tropical form, but we also find single specimens of them at a great distance from these borders. Calotropis branches were found in the old Egyptian tombs of Dakhel. This rapidly-spreading plant, which the present inhabitants of the oases hang above their doors as a charm against evil spirits, has been consequently indigenous in the oases for the last 2000 years.

It follows from what we have said that the circumstances of the vegetation of the Lybian oases enable us to perceive no connection between that and the flora of the Nile Valley, but they do enable us to see the connection between it and the flora of the Mediterranean coast lands; and that, however near the two districts may be to each other, they have very little in common of a nature calculated to impress their flora with the seal of affinity.

Strictly speaking, the flora of the Lybian Desert in the regions traversed by us, especially between the Nile and the oases, belong probably to the regions which are the poorest in plants of any that we know of in the world. Our observations there were confined to a dozen sorts, which moreover represent an extremely small number of separate kinds. Still the desert even in this its most torpid shape, appears to be nowhere wanting in vegetable germs. A north-west wind charged with a minimum of moisture is able at once to vivify the dormant energy which through long years has lain in a state of apparent death, and to produce that semi-vegetation to which we may give the name of botanical *vita minima*. If occasionally there should fall here and there an exceptional shower, such as we experienced early in February (to be sure, as regards many localities, 100 years may probably pass away before it comes to their turn to receive such a moistening), then the plants develop themselves to the normal life, corresponding to their ephemeral nature; they produce blossoms and fruits, and, with the aid of the wind, furnish the desert with fresh germs of life.

The principal cause of the remarkable scarcity of plants on the Lybian side of the Egyptian Desert is owing to the prevalence of porous limestones there, which are unable to make any economical use of the moisture which they have once received, whilst on the Arabian side the down falling rain carried far away over impermeable strata, or confined as in a cistern, may be stored up for a long time.

The problem of desert vegetation is however less to be sought for in the nature of the external conditions which environ it, than in those of their internal organization. Where the camel becomes strong and fat the horse may be starved to death, and the air of a rainless European summer, in which the crops wither and die, would suffice to cover the Lybian Desert with fresh and smiling vegetation.

Dr. SCHWEINFURTH afterwards made a few remarks in German (which Mr. Ravenstein translated) expressive of his gratitude for the reception he had met with, and congratulated England that her material prosperity had not interfered with the advancement of science.

Saturday, August 22nd.

Dr. CARPENTER read a paper on the result of the 'Challenger' researches into the physical condition of the deep sea. The paper, however, was essentially the same as the lecture delivered by the author on the temperature of the Atlantic at the Royal Institution of Great Britain in March last. (See our July number, p. 109.)

Monday, August 24th.

Mr. T. J. HUTCHINSON, late Her Majesty's Consul for Callao, read a paper "On the Natural Resources of Peru."

The author commented on our earliest knowledge of the history of Peru, observing that the country, even in early times, was as famous for its commerce and industry as for its precious metals. He considered the modern Peruvians to be the most industrious inhabitants of South America, as evidenced by their cultivation of cotton and sugar-cane, and dated the establishment of their commercial status from the beginning of the Pacific Steam Navigation Company's inauguration in 1840. The condition of native manufactures, joined to that of agriculturists, seem to point unerringly to success in a commercial point of view for a nation as it were instinctively industrious. The author then proceeded to notice the enormous amount of mineral

wealth in the Andes, now about to be opened to the world by means of railways. Hitherto these rocky mountain masses had rendered intercommunication impracticable from the difficulty of transport across their almost impassable barriers. Foreign Office Reports were quoted, as furnished through the Admiralty from Rear-Admiral Cochrane, the present Commander-in-chief in the Pacific. Recent findings of guano show an approximate amount of 9,294,500 tons, and exports of nitrates from Iquique have increased cent per cent in less than three years. In the author's opinion, Peru seems likely to reach the position before many years of being one of the first South American Republics, as regards commercial prosperity. Drawings of various cuttings and tunnellings of the railways (some of which are now finished by the contractor Mr. Henry Meiggs) accompanied this paper.

ASIA.

Mr. DELMAR MORGAN afterwards read a paper "On Travels beyond Three Seas," by Athanasius Nikitin, Merchant of Tver, 1466-1472.

These memoirs were first discovered by Karansin, who paid a high tribute to their importance in his history of Russia; they have since been referred to by other writers, but no commentator has yet given a correct idea of the narrative or of its place in European literature. The present attempt to give an English version of these travels has been suggested by an article which appeared a few years ago in the *Transactions of the Imperial Academy of Arts and Sciences*, by an able Russian savant and archæologist, M. Sresneffsky, who devoted much labour and research to a critical review of the diaries of Nikitin. The few notes added are chiefly from well-known English works.

The 15th century, remarkable in the annals of Western Europe for a special desire to become acquainted and establish relations with the distant East, is not without its reminiscences to Russians, whose ancestors took their part in the progress of the times and the march of events, as far as circumstances would allow. The development of the kingdom of Muscovy, following the overthrow of the Tartar power during the reign of Ivan III., opened out new countries to the enterprise of Russian merchants, and, towards the close of the 14th and beginning of the 15th centuries, they traded with India, Persia, and Central Asia. Commercial intercourse was succeeded by closer political relations, and we read of interchanges of envoys between the Grand Dukes of Muscovy and the rulers of Transcaucasia and Persia. It was on the occasion of the departure of one of these embassies from Russia that Athanasius Nikitin, a merchant of Tver, started for the East. Taking with him his merchandize in two sailing ships, he descended the Volga to Astrakhan, where he was attacked by Tartars, and lost all his goods; but escaping himself in another vessel, after experiencing a violent storm in the Caspian Sea, he landed safely at Derbend. Here Nikitin and his companions were in the dominions of the Shirvan Shah of Shamakha, who received them kindly, but refused to accede to their request to be sent home to Russia. After wandering about Daghestan for some time, Nikitin at length set sail for Persia from Baku in 1466 or 1467, and landed at Barfurush, on the coast of Mazanderan. Thence he crossed Persia, visiting the most important towns and commercial centres, and arrived at Ormuz, on the Persian Gulf. Three years later, on his return journey through Persia, he visited the "horde" of Uzun Hassan of the Turkoman tribe of Ak-koinlu (white sheep), whose empire extended over the whole of Persia and a great part of Asia Minor, and at one time threatened to shake the power of the Turks. Nikitin described the unsettled state of the country, owing to the ambitious designs of Uzun Hassan and the revolts and rivalry of his sons and vassals; and his remarks are the more valuable, as they entirely confirm the records of the chroniclers. Sailing from Ormuz the week after Easter, 1469, Nikitin approached for the first time the shores of India at the Peninsula of Gujerat; he touched at Diu and Cambay, continuing his voyage to Chewul, where he landed and crossed the Ghaut Mountain, entering the Deccan and visiting the towns of Junir and Kulburga on his way to Beder, where he stayed for some time. Beder has now lost all its importance, but in those times it was the capital of a powerful Muhammadan state, and a great emporium for trade.

Our traveller visited the fair at Aliand (Allund), instituted in memory of Shah Alla ad Deen Hildji (1297-1347), who made himself notorious by his terrible march through the peninsula with 300,000 cavalry, and 2700 elephants, devastating the country. Nikitin also accompanied the Indians to their sacred city of Parvat, not Ellord, as Karumsin and others believed, but most probably Parvattum, or Perevattum pagoda, on the right bank of the Kistna (16° 12'), south of Hyderabad, described by Hamilton as the site of one of the Buddhist shrines, marked to this day by some beautiful remains. In Nikitin's time, this shrine was visited by pilgrims from all parts of India. It contained, among other objects of Hindoo worship, twelve temples covered with sculptures, illustrating the miracles of Buddha; a statue of that god, resembling that of the Emperor Justinian, at Isargrad, or Byzantium; a black ox of stone covered with gilding, &c. Among the other places of interest described, were Bidjnaghur, the capital of the great Indian kingdom; Rachiur, famed for its diamond mines; and Kulor (Culoor), a great industrial centre.

After the personal narrative of his journey, Nikitin records his observations on the country, and its products; the people, their morals, customs, and religion; the government, the army, &c.; and some of these remarks are the more valuable as they are not to be found in the writings of any of his cotemporaries.

It may be observed that, in his time, there were two principal kingdoms in India, the capitals of which were—the Indian Chiumidar-Bidjnaghur, and the Muhammadan Khorassan-Beder. Of the former, he communicated little, except that its prince, Kadam, was very powerful, and had a large army; but of the latter, he notes that the ruling classes were all Muhammadans of Khorassan, a proud race of conquerors, riding in armour, their Indian subjects poor, ill fed, nearly naked, swift runners, with shield in one hand, bow and arrows in the other. The Sultan's army numbered 300,000 men, besides elephants, and the contingents of his great lords or feudatories. The description seems almost fabulous of the splendour of the Sultan's Court, of the grand ceremonial processions on the Muhammadan festivals, and of the wars and military exploits of the great Lord Meliktuchar, attached to the suite of the young sultan.

After three years' stay in India, Nikitin departed from Dapul, then a prosperous seaport, on a 'tava,' or merchant vessel bound for the Persian Gulf. After being wrecked and falling into the hands of robbers, he reached Muscat, whence a few hours' sail landed him at Ormuz. He then travelled through Persia to Trebizonde, and, after crossing the "Stamboul daria," or Black Sea, to Balaclava, he could offer up his thanks with a grateful heart, exclaiming, "Thank God, I have crossed three seas."

By what route Nikitin returned to Holy Russia is uncertain; but as he died at Smolensk before reaching his native Tver, it may be inferred that his road lay through the territory of the Khan of the Crimea, and the Prince of Lithuania.

His record of his travels entitles him not only to claim rank as a distinguished Russian of the 15th century; but as worthy to be classed with Di Conti and Vasco de Gama.

M. N. DE KHANIKOF, in the name of his countrymen, thanked Mr. Morgan for the trouble he had taken to introduce Russian geography to an English audience.

"On the Survey of Palestine," by Lieut. CONDER, R.E.

This survey is confined to Western Palestine, containing about 6600 square miles, which is bounded by the Jordan and the sea, and extends from Dan to Beersheba. It is divided into five geographical districts, two on the south comprising the hill country of Judæa and the plain of Sharon, the third containing the plain of Esdraelon and its boundary chains, the fourth the hill country of Galilee, and the fifth the Jordan Valley. The country of the Beni S'ab, or Shephalah, west of Nablus, was unknown until visited in this survey. The author describes the commencement of the work (1-inch scale) in October 1871, and the share taken in it by Mr. C. F. Tyrwhitt Drake, who died on the 23rd of June last. The map was prepared on Sir H. James's system of tangential projection, in sheets containing 30' of longitude and 20' of latitude. Six of the proposed twelve are complete, and three are in England. The first base was connected with the trigonometrical point at Jaffa, the second being established at Esdraelon: this was 4½ miles long, and the difference between its measured and calculated lengths gave an error of only .03 per cent. The average length of the triangle's side was about 15 miles, but never greater than 10 in the Judæan hills; and every possible check appears to have been employed in all cases with an encouragingly minute amount of error. The rate of work rose from 60 square miles per month to about 180 in October 1873, and then, with an extra man, gave a steady average of 280. All is done on horseback, and the method is most fitted for military reconnaissance. The heights are obtained by Abney's clinometer, sketches of hill tops, aneroid observations, thermometrical readings, &c., and astronomical bearings were constantly obtained as rough checks. As to names of places, the author observes that the original Hebrew names are still to be found under slightly modified forms of the Arabic. The collection and correction of these, tending to elucidate geographical passages in Scripture, were carefully attended to. The number obtained was very great (seven or eight times more than in any previous map), averaging two per square mile. Seventy special plans of antiquities not before satisfactorily explored, are here mentioned; and seven churches and two sites of towns are stated to have been before entirely unknown. The antiquity of ruins in Palestine has been much exaggerated, many supposed to be Jewish or Phœnician turning out to be Crusading or Saracenic. The identifications of the altar 'Ad, the site of Ænon, Zaretan, Gilgal, Scopus, Oreb, Zeeb, Samson's Tomb, Archelais, Ecbatana, Sozuza, and other places mentioned in Scripture, were made during the survey, and various other points and discoveries of archæological interest are discussed. As to climate, there is an entire absence of ozone during the east wind; the mirage is not dependent on heat only, but requires also moisture; and the rise and fall of the barometer has no reference to storms in the Jordan Valley, though a safe guide in the hills. The forest of Sharon has been found extending for miles on the northern part of the plain; and altogether the seasons, rainfall and natural vegetation of modern Palestine resembles very closely that of Biblical times. The vine, now unknown, was once much cultivated. A volcanic centre has been discovered in the plain of Esdraelon, and a tertiary volcanic lake south-west of Carmel.

"Notes on a Recent Journey East of the Jordan," by the Rev. Dr. J. L. PORTER, D.D., LL.D.

Eastern Palestine is divided from Western by the valley of the Jordan, which extends from the base of Hermon to the borders of Edom, a distance of 150 miles. For about 130 miles its surface is below the level of the sea, its depression at one place being 1312 feet. This great chain gives the country eastward its most striking physical feature. Viewed from the west, it appears an unbroken mountain chain, but, when ascended, a table-land is seen to stretch from its summit into Arabia. The central erection rises into wooded heights, with an average elevation above the plateau of 600 feet: this is mount Gilead, while the southern table-land is Moab, and the northern Bashan. The western side of the country is deeply furrowed by ravines, three of which are historically important: 1, the Arnon, which separated the Moabites from the Amorites; 2, the Jabbok, which was the northern border of the Ammonites; and 3, the Hieromax or Jarmuk, the boundary between Bashan and Gilead. The country was the scene of some of the most remarkable events in early Bible history, such as the raid of the Eastern Kings upon Sodom and the conquests of Israel under Moses. Questions of importance arise in connection with those events: Are there any traces, monumental or traditional, of the aboriginal races, or can the line of conquests be followed? The ancient inhabitants had some very marked characteristics; they were to a large extent migratory; they were subject to wild outbursts of passion; they were celebrated for unbounded hospitality; they had a peculiar costume and a peculiar accent. It is therefore important to enquire whether there be anything in the physical features, natural resources, or geographical position of the country that would account for these characteristics, or whether any of them still exist. The author proposed to show the conclusions he had arrived at upon these and other points, while giving a sketch of his recent journey. He left Jerusalem on the 13th of April, but was unable to cross the Jordan at Jericho, because, as stated by Joshua, the river at that season "overfloweth all his banks." He travelled up the plain to Damich, and crossed a ferry beside the ruins of the Roman bridge, over which ran the ancient road from Neapolis to Geraxa and Philadelphia. He showed that the dress of the people beyond the river is different from that of the western tribes, and of a more primeval type; their pronunciation of certain words is also different. He ascended Jebel Osha, the highest peak of the Gilead range, and identified it with Mizpah, where Jephthah assembled the Transjordanic tribes. He also showed that Es-Salt is the Ramoth Gilead of the Bible. He travelled south to Arak-el-Emîr, and described the remarkable excavations and classic ruins of the palace of Hyrcanus. Thence he went to Heshbon, and pointed out how it commanded the passes from the plateau of Moab to the Jordan Valley, thus rendering it necessary for Moses to ask permission of Sihon to pass through his territory. The western brow of the plateau is deeply furrowed, and the projecting peaks near Heshbon formed those "heights of Pisgah" which looked "toward Jeshimon," *i.e.*, "the desert" beyond the Dead Sea. He described the ruins of Nebo, showing that it was a town which gave its name in ancient—as it does in modern—times to some peaks around it, one of these peaks bears a name which is probably a corruption of Pisgah, and the river from it is similar to that described in the account of Moses' death. The author went to Rabbath Ammon over a table-land rich in pastures, and dotted with ruined towns. He urged the importance of excavations at Rabbath, as likely to be productive of interesting archæological discoveries. He travelled thence to Gerasa, through the semicircular region of mountains skirted by the ravine of the Jabbok, and illustrating the statements in the Bible regarding the strength of the borders of the Ammonites. He suggested Neby Hûd, a noted sanctuary between the ford of the Jabbok and Gerasa, as the probable scene of Laban's covenant with Jacob, and proposed to identify Gerasa with the long lost Mahanaim. From Gerasa he made an adventurous journey through an unknown region to the plain of Haurân, following the line of an ancient road; and he gave reasons for believing that this was the route by which Abraham and Jacob entered Palestine, and by which Moses invaded Bashan. He denied the identity of Dera with the Edrei of Og, maintaining it to be the Adraha of the Peutinger Tables, and followed the Roman road there laid down to Bozra. Thence he went north to Jebel Haurân, visiting its old cities and describing their

architecture. He argued that some of the private houses in those cities are much older than the Greek temples beside them, giving measurements of a few of the massive stone doors. Here were two colossal heads of Astarte, with the crescent on the forehead which gave that deity the name found in Genesis, Ashteroth-Karnaim. The ruined temples and palaces of Sîah contain inscriptions bearing the names of Herod the Great and Agrippa; and there is one in Nabathean characters of a very remarkable type, apparently recording the erection of a statue to a certain Malkath about 30 B.C. From Kenath, he crossed the plain of Bashan to Mezarib, and then, turning southwards, passed over the northern ridge of Jebel Ajlûn, visiting several cities of Decapolis, and finally crossing the Jordan Valley to Bethshean. In conclusion, the author strongly urged the importance of a regular survey of the whole country, as calculated to illustrate Biblical geography and archæology.

Colonel BIDDULPH, R.A., communicated a short abstract of the journey of the Kashgar Mission, from their departure from Marri in the Punjab, on the 15th July, 1873, up to their return across the Great and Little Pamirs, in April last. Full notices of the progress of this expedition have already appeared in our columns, and will be found in the April number, p. 19, and also that of July, p. 139, to which we beg to refer our readers.

Tuesday, August 25th.

"On Surveys in Ireland," communicated by the Ordnance Department.

The circumstances connected with the Government Surveys of confiscated lands in 1586, 1609, and 1652 are here succinctly narrated—the last (the "Down" Survey) being given more in detail. After a sketch of the origin of the English Ordnance Survey, its extension in 1825 to Ireland (when the triangulation commenced on Divis Mount near Belfast), and subsequent operations are described, and the various uses to which the resulting maps may be put are recapitulated—the older surveys being shown to have been but portions of various oppressive plans, whilst the operations of the present scheme relieve all classes from unequal taxation, simplify the conveyance of land, and in various ways act equitably for the good both of individuals and the State.

A paper was then read by Captain ABNEY, "On the Multiplication of Maps and Plans in the Field."

The chances of victory are greater if the officers in command possess a thorough knowledge of the ground. Even the autumn manœuvres offer instances of this; and the escape of the Prince of Wales by taking a path through a bog, upon which his pursuers did not venture to follow, is a case in point. It is therefore important not only that every officer should be furnished with a correct map of the country, but likewise that there should exist facilities for multiplying reconnaissance surveys with rapidity, so that they may reach the hands of the officers concerned within a few hours after they have been made. The time when officers were obliged to sit up all night in order to furnish a few copies of plans has now passed, and maps drawn in lithographic ink can be multiplied at the rate of 100 an hour. Captain Abney considers that the necessity of using greasy ink, and of carefully guarding the prepared paper against finger marks and moisture detracts from the utility of this process. He thinks that the ink invented by him, which is not greasy, and by means of which three transfers can be taken from drawings made on ordinary paper, is deserving the preference.

In photo-lithography, which is particularly useful for enlarging plans, so that an officer charged with a reconnaissance may insert additional details upon them, he has likewise introduced certain improvements. He coats the paper with gelatine, and renders it sensitive to light by adding bichromate of potash. The action of light renders the salted gelatine insoluble in water, and incapable of absorbing it, and by placing this sensitive paper under a negative, upon which the black lines of the original are represented by transparent lines, and the white of the paper by an opaque deposit of silver, the lines printed on the gelatinized paper will become insoluble, whilst the white portions can be washed away with hot water. Thus far, Captain Abney's process is identical with that employed by Sir H. James. The paper, having been taken from the printing press, is then steeped by him in cold water, thus stopping the action of the light almost entirely; the surface moisture is got rid of by blotting-paper, and a soft gelatine roller, charged with greasy ink, is then passed over it. The greasy ink adheres to those parts which have been acted upon by light, and a facsimile of the original is thus produced. A transfer is then taken on zinc, and the paper may be rolled in again, for a second transfer. This system of printing, which Captain Abney calls papyrography, has been adopted in the army.

The same process is applicable to the multiplication of ordinary photographic views. In that case a reversed negative is transferred to gelatinized paper, and rolled in with lithographic ink. From this paper (and not from any transfer to stone or zinc) forty to fifty copies can be printed upon ordinary paper.

The equipment of each division of the British army now includes a lithographer's, a photographer's, and a typographer's waggon. These waggons are supplied with stores for a three months' campaign, and together with the Telegraph Troop of the Royal Engineers, they are placed under the Intelligence Department of the army.

Major JED. HOTCKKISS, of Virginia, expressed his satisfaction with Captain Abney's paper, and explained the manner in which reconnaissance surveys were made, and plans multiplied, in Stonewall Jackson's army.

The PRESIDENT, in thanking Captain Abney for his interesting paper, referred to several instances in the Franco-German War, in which the art of photo-lithography proved of great service.

"On the Reconnaissance of a new or partially known Country." By Captain WARREN, R.E.

In this paper Captain Warren lays down the experience gained by him in the course of the Palestine Survey, and furnishes valuable hints to explorers and others, whose business it is to supply maps from actual surveys.

"On the Russian Expedition to Khiva," by J. A. MAC GAHAN.

The Russian Campaign against Khiva was remarkable for the admirable way in which the expeditionary force was supplied with every requisite for a march of ninety days across a waste of sands. The operations of the Topographical Corps merit special attention. The Russians keep pace in the survey of the country with their advance in Central Asia. Even flying columns and embassies to neighbouring states are accompanied by officers trained to make surveys and to determine the position of places astronomically. The visits of Struve and Kaulbars to Khiva and Kashgar respectively, are instances of the kind. Flying detachments explored the routes leading to Khiva long before the late expedition was undertaken, and the expeditionary force never moved until the country as far as the next camping-ground had been explored by a flying force, and the amount of water each well would afford had been estimated. The only route not explored in this manner was that from Adam Krilgan to the Oxus, it being impossible to do so in the face of the Khan's troops, and hence Kaufmann's march came near ending disastrously. The information obtained by the Jighits or native guides could not always be trusted. The trigonometrical survey of Russian Turkistan is progressing favourably; and the time when the whole of Central Asia, as far as British India, will be laid down correctly on our maps, is not far distant. The extensive explorations carried on by Russian travellers but rarely become known to the outside world, for the Russians confine themselves to a dry *résumé* of

facts. During the Khivan campaign the operations of the Topographical Corps were most extensive, and the surveys were of the most minute nature. On several occasions the surveyors, who were always to the front, narrowly escaped being made prisoners by the Turkmen. General Kaufmann, though fully appreciating the value of the work done, exhibited but little consideration for the workmen, amongst whom, as far as Mr. Mac Gahan's experience went, Lieutenant Servotsky was one of the most indefatigable. These surveyors have probably decided by this time whether the Oxus, at some former period, flowed into the Caspian. The author describes the soil of Khiva as being exceedingly fertile, yielding crops of wheat, barley, and rice not to be surpassed elsewhere.

M. DE KHANIKOF gave some notice of the results obtained within the last few years by Russian explorers with reference to the old bed of the Oxus. He thought it had clearly been established that the Oxus, or at all events, a branch of it, flowed formerly into the Caspian. This communication had been destroyed by the Government of Khiva, who cut off the Caspian branch by means of five dams, and turned the whole of the river into lake Aral. This was done in order to deprive the Turkmen of a supply of water, and thus to render them dependent for supplies of that indispensable element upon Khiva. Traces of old buildings and gardens had lately been discovered in the old bed of the Oxus.

M. DELMAR MORGAN maintained that the change in the course of the Oxus was due to natural causes, and not to artificial ones, as believed by M. de Khanikof. He referred to the progressive desiccation of a large portion of Central Asia, and to a belt of upheaval, extending from the Black Sea to the Southern Caspian and further East, and thought that causes, such as these, were sufficient to account for certain changes in the hydrographical features of that country.

"Notes on some Roads in Northern Persia, and on the Russo-Persian Frontier," by Lieut. W. J. GILL, R.E.

Lieutenant Gill last year accompanied Colonel Valentine Baker on a hurried tour through Northern Persia, and visited several districts, including a portion of the Lower Atrek River. As his account contains data of considerable value, we propose to publish the whole of his paper in our next number, together with the map accompanying it.

"Note on the International Congress of Geographical Sciences to be held at Paris," by M. CHARLES MAUNOIR, Secretary of the French Geographical Society.

The Organization Committee appointed by the Geographical Congress held at Antwerp in 1871, prevailed upon the Council of the French Geographical Society to undertake the management of a second gathering of geographers, which is to take place at Paris, in 1875. The author gives details of the constitution of the various committees, and of the work to be done. In addition to an Honorary Committee, a General Committee and various other business bodies, there will be the following scientific sections:—Mathematical Geography and Surveying Hydrography, Physical Geography, History of Geography and Ethnography, Statistics, Geography in Schools, Geographical Exploration. A provisional board of inquiry has been appointed, to which questions can be referred, each of the scientific groups being required to prepare a series of these. Upon the Honorary Committee all nations are represented, and the countenance of the French Government, and of the municipal authorities has been obtained. Members of the Congress pay a minimum subscription of fifteen francs, and the regulations concerning the proposed exhibition of objects specially interesting to geographers will shortly be published. The Congress will meet on the 31st of March, 1875, and will last, at most, for ten days. The various sections will meet in separate rooms in the mornings, and general meetings will take place in the afternoon. The exhibition will remain open until the 30th of April, and the prizes awarded in accordance with the verdict of an international jury, will be distributed on the closing day of the Congress. Subscribers will be entitled to receive the *Proceedings* of the meeting,

This communication concluded the proceedings of the Section, and Admiral OMMANNEY proposed a vote of thanks for the very efficient manner in which the President had attended to his office. A vote of thanks was likewise voted to the Honorary Secretaries,

The next meeting of the Association will take place at Bristol.

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FRENCH GEOGRAPHICAL SOCIETY.

Meeting of August 7th, 1874.

M. TISSOT, French Minister in Morocco, and the Rabbi Mardokhaï Abi Seroûr were present at the meeting.

The Abbé DURAND read the minutes of the last meeting.

M. CHARLES MAUNOIR having communicated the contents of the correspondence, M. TISSOT, whose large map, showing his itineraries in the north-western portion of Morocco, was exhibited in the room, said that in submitting to the Society the results of his travels in that country, he would only mention a few of the facts which changed our present knowledge of its comparative geography. For instance, he does not agree with M. Vivien de St. Martin as to the identification of Lake Cephisias. Having studied the texts of Scylax and Pliny when standing on the ground they described, M. Tissot's conclusions, as to the ancient geography of the coast-line from El-'Arâïsh to Salâ, are worthy of the greatest attention. On the subject of physical geography, he said that he had not observed any connection between the Sebkha Râs Ed-Doûra, nor between the Loukkos or Lixus and the ocean. He found between the Loukkos and the ocean a barrier of downs, some being of recent and others of ancient quarternarian formation. The site of the ruins of the ancient town of Lixus is found at the foot of the quarternarian downs.

The President, M. DELESSE, on behalf of the Society, begged to thank M. Tissot for the solicitude he had shown in improving our knowledge of the geography of that part of Africa, and also for his generosity towards the Society in offering the results of his travels, which must have been achieved under serious difficulties. The President, also in the name of the Society, through M. DUVEYRIER, wished the Rabbi Mardokhaï Abi Seroûr, who was about to return to Morocco, a successful journey, promising him, at the same time, all possible assistance.

The Marquis de COMPIEGNE gave an account of his own and M. Marche's travels and geographical work on the Ogôwé River, extending over 213 kilometers east of San-Quita, a town 61 kilometers north of Pointe Fétiche The Marquis was still suffering from sore legs, which precluded him from giving more than a few notes from his journal, elucidating his map of the river on the scale of 1:500,000. Before accomplishing his journey he regretted that wars and the receding waters obliged him to return after he had reached the confluence of the Ivindo, a large tributary on the northern bank of the Ogôwé.

On the 9th of January, the day of the death of the King of the Galloi, he began his journey. At Obanga he saw a canal which united the Ogôwé with the Gabûn. The river then runs through forests, where there are large rocks, to which the negroes make fetish. Higher up there were rapids, and rocks level with the water. After four days' journey through a desert country he came to a village of the Bakalé. There he met with the ugly people called the Okota, who are great slave-dealers. He has composed a vocabulary of their language. The King, who was charmed with the presents he received from the Marquis, refused on the following day to allow him to proceed on his journey, but ultimately gave way through

fear. Travelling on the Ogôwé is very slow, on account of its rocky bottow, 3 miles a day being the average rate of progress.

Before arriving at the country of the Yalimbongo tribe the river seems to descend from a mountain. Here there is abundance of food compared with the country of the Okota. The active volcano of M. Walker, on inspection, proved to be simply a mountain, with *a lake* on its summit. Here the crews of M. de Compiègne almost mutinied.

Eastwards from the Yalimbongo, the Marquis came across the tribe of the Apinji. These Apinji are diminutive, mild men, of business-like habits. They are exposed to the depredations of the Oshieba, who plunder their plantations on the right (north) bank of the river. Here several of the crew deserted, and the remainder refused an increase of pay as an inducement to continue the journey; they, however, repented and started again with the Marquis. Farther on the river is obstructed by rapids, behind which it widens to about a mile, and becomes more navigable. Another Bakalé village was here seen, before the large island of Ochunga; and afterwards the first village of the Okanda tribe was reached, which is situated in a range of mountains.

The Marquis de Compiègne stayed a considerable time in the Okanda country and had frequent intercourse with the Oshieba and Banguin tribes. He describes the Okanda as a fine race of men, who enjoy the reputation of being terrible sorcerers. They cultivate the banana and maize. Their plantations are often plundered by the Oshieba, a kindred tribe of the Fan or Pahuin.

The results of the important work of M M. de Compiégne and Marche, were a worthy conclusion of the business of the session.

H. D.

Bulletin for March.

THIS number opens with a detailed description of the manner in which M. Dupuy de Lôme proposes to shorten and improve communication across the Channel. This he does by building a sort of oval-shaped harbour outside Calais, connected with the shore by a pier, but at a sufficient distance to allow free play for the wash of the tide between. Dover he considers already well provided for the reception of large vessels by its Admiralty Jetty, at the extremity of which there is a depth of 40 feet at low water. Vessels about 400 feet in length will be built to carry the trains bodily across, without the trouble and delay of a double shipment of passengers and goods. There is this to be said in favour of M. de Lôme's plan, that it is evidently practicable, and very inexpensive compared with one or two gigantic schemes which have been recently broached. General Dastugue contributes a concise little article on the meteorology and products of the plateaux and deserts of Western Algeria, a region which, from the extraordinary range of its temperature (59° Fahrenheit in winter) must be classed among those countries where extremes of climate prevail. It is most favoured in regard to its mineral resources, lead, copper, manganese and marble, having been all of them worked with tolerable success. Next follows an account of Chimborazo, Altar, Cotopaxi, and other peaks of the Cordilleras, being a translation of a letter from M. Alphonse Stuebel (who, with Dr. W. Reiss, undertook the ascent of some of the mountains mentioned) to the President of the Republic of Ecuador. A paper on a new method of projecting maps embracing a large extent of country, on what is known as the *gnomonic* projection, shows the northern hemisphere spread over eight triangles, and enters into the mathematical features of this method. But it exhibits manifest peculiarities, not to say distortions. The effect in the map before us is greatly to exaggerate the countries in the southern angles of the triangles, and to really convince one that all these elaborate methods of projecting the details of a sphere on a plain surface are as unsatisfactory as attempts to square the circle. The *Bulletin* closes with a review of an English pamphlet, "The Slave Trade in Africa in 1872," which was written originally in French by M. Berlioux, the Professor of History at the *Lycée* of Lyons.

Bulletin for April.

THE most remarkable article in this month's *Bulletin* is an exhaustive *resumé* on the geographical events and doings of the past year, by the energetic Secretary, M. Maunoir. From it we gain some knowledge of the progress in map-making in France, and in surveys made under the direction of French officers. It appears that three surveyors are engaged on a re-survey of the French coast-line between Italy and Spain. A new survey of the northern part of the estuary of the Gironde was urged by the Chamber of Commerce at Bordeaux, and recently executed by M. Manen. Officers are at work in Algeria and Socoa; and off the west coast of New Caledonia the frigate 'Chambeyron' has examined the passages between the shore and the numerous reefs there. One hundred and thirty new charts have been published during the year under review, in addition to the 3155 already available. The *Carte de la France* has made good progress under the direction of the War Department, and only sixteen sheets, seven of which include Corsica, now remain to be completed. The first batch of sheets of this great undertaking appeared in 1833, and the total number of 274 sheets will probably be finished in two or three years. Like our own Ordnance Survey it has proved a slow though most important undertaking. Two other maps deserve mention: a reduction of the above large scale map on the more convenient scale of 1:320,000, which is making satisfactory progress, and a two-sheet map of Mexico on the scale of 1:3,000,000, accompanied by an explanatory notice.

We have next a review, by M. Charles Grad, of Herr Grisebach's work on the distribution of vegetation over the surface of the globe. The flora of the world is divided by him into twenty-four groups, each of which is subject to peculiar physical conditions. Each of these is considered separately by the author, and he adds some thoughtful remarks on the process by which dissemination is carried on. M. Grad considers the work a valuable contribution to a branch of science which had already received attention at the hands of Humboldt and De Candolle. A suggestive and valuable note by Colonel Yule also finds a place in this month's *bulletin*, in which the gallant Colonel enumerates several points of special interest, worthy of being investigated by the French travellers, Messrs. Fan and Moreau, in their expedition to Burma. The source of the Irawaddy in particular he cites as a mystery well worthy of an attempt to solve.

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